Environmental Cost Element Structure Level 3 Dictionary

ECES #	ECES DESCRIPTION	UOM
.01	**PROGRAM MANAGEMENT, SUPPORT & INFRASTRUCTURE (OPTIONAL)**	
.01.01	**PERSONNEL RESOURCES** Phase 8 • This element includes personnel who oversee and plan the environmental program, develop and coordinate policy. Activities include development of guidance, resolution of environmental compliance and project integration issues, and management of multiple projects.	**LS**
.01.02	**PROGRAM SUPPORT** Phase 8 • This element includes resources needed to provide support to the program including travel, training, public affairs, community relations, engineering support, legal support, administrative support, regulatory agency support, procurement of equipment and supplies for offices. Consultants who provide program planning and program management support are also included.	**LS**
.01.03	**PROGRAM INFRASTRUCTURE** Phase 8 • This element accounts for resources associated with development and maintaining a Governmental agency's infrastructure and property ownership. This includes overhead elements such as insurance, interest, fees, rent, warehousing, building maintenance, and equipment maintenance required to implement environmental programs.	**LS**
.01.04	**GOVERNMENT PERSONNEL RESOURCES** Phase 8 • This element includes Government personnel who oversee and plan the environmental program, and develop and coordinate policy. Activities include development of guidance, resolution of environmental compliance and project integration issues, and management of multiple projects.	**LS**
.01.05	**GOVERNMENT-PROGRAM SUPPORT** Phase 8 • This element includes Government resources to provide support to the environmental program. This would include resources for travel, training, public affairs, community relations, engineering support, legal support, administrative support, regulatory agency support, procurement of equipment and supplies for offices, and consultants who provide program planning and program management support.	**LS**
.01.06	**GOVERNMENT PROGRAM INFRASTRUCTURE** Phase 8 • This element accounts for Government resources associated with maintaining a Government agency's infrastructure and property ownership. This includes overhead elements such as insurance, interest, fees, rent, warehousing, building maintenance, equipment maintenance, etc. required to implement environmental programs.	**LS**
.01.9x	**OTHER** Phase 8 • This element includes program management work not described by the above-listed subsystems.	**LS**

ECES #	ECES DESCRIPTION	UOM
.02	**PROJECT MANAGEMENT & SUPPORT (Operable Unit/Solid Waste Management Unit, Project Specific)**	
.02.01	**PROJECT MANAGEMENT/SUPPORT/ADMINISTRATION** Phase 1 to 6 • This element includes personnel and resources for the management and control of project activities. The element also includes scoping, planning, estimating, executing, tracking, controlling, reporting, analyzing, and closure of the project. This element also includes direct management of the project and the support and administrative functions needed for successful project management.	**LS**
.02.02	**COMMUNITY RELATIONS** Phase 1 to 6 • This element includes activities required to inform the public of project activities and appropriately involve the public in decisions related to environmental management activities of sites.	**LS**
.02.03	**REGULATORY INTERACTION** Phase 1 to 6 • This element includes submittals and interface activities with local, state and Federal regulatory agencies.	**LS**
.02.04	**INSTITUTIONAL CONTROLS** Phase 1 to 4 • This element includes measures taken to protect the public health and safety from hazardous, toxic, and radioactive contaminants. This can include such measures as posting warning signs, placing fencing around the site, etc. See also Fencing in ECES X.05.14. Phases 5 and 6 • This element includes the maintenance and inspection of institutional control such as repair or replacement of signs, fencing, gates, documents, and other activities. If institutional controls are constructed during the SLTM Phase, use 4.02.04 to capture the construction cost. Phase 8 • This element applies to institutional controls placed at the site wide level where costs cannot be allocated to distinct projects. If institutional costs are already included under X.01.xx, Program Management, Support, and Infrastructure, do not include in this element.	**LS** **LS/YR** **LS**
.02.05	**POST DESIGN SUPPORT** Phase 3 and 4 • This element includes engineering and design activities for support of procuring construction (remediation, D&D, etc.) and identifying long lead items, pre-bid and pre-award activities.	**LS**
.02.06	**PROCUREMENT - EQUIPMENT & MATERIALS** Phase 2 to 5 • This element includes personnel and resources used in the procurement of the project equipment and materials. Note: Charges for procurement could be included in the cost of the equipment and materials under the various technologies and structure elements.	**LS**
.02.07	**A/E SUPPORT** Phase 2 to 5 • This element includes architectural and engineering oversight and support during various phases of the project or site.	**LS**
.02.08	**CONTRACTOR CONSTRUCTION MANAGEMENT** Phase 2 to 4 • This element includes oversight of construction projects and oversight of AE contractors by non Government personnel.	**LS**

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.02.09	**GOVERNMENT CONSTRUCTION MANAGEMENT** Phase 2 to 4 • This element includes oversight of construction projects and oversight of AE contractors by Government personnel	LS
.02.10	**INDEPENDENT CONTRACTOR VERIFICATION OF CLEANUP OR REUSE** Phase 4 to 6 • This element includes costs associated with obtaining an independent third-party verification that environmental goals and performance have been obtained.	LS
.02.11	**ENFORCEMENT** Phase 1 and 2 • This element includes activities related to the identification and enforcement of responsibilities of the potentially responsible party (PRP). Includes PRP searches, negotiation support, and documentation of finding.	LS
.02.12	**ASSET RECOVERY** Phase 1 to 6 • This element captures the money received from sale of project assets such as clean equipment, facilities, and materials.	LS
.02.13	**CONFIGURATION MANAGEMENT** Phase 3 to 6 and 8 • This element provides for an integrated management program that establishes accuracy and consistency among design requirements, physical configuration, and facility documentation and that maintains this consistency throughout the life of the facility as changes occur.	LS
.02.14	**PROJECT SAFETY AND HEALTH** Phases 1 to 6 • This element includes safety and health costs specifically associated with the project. Example of such costs include support and participation in Integrated Safety Management (ISM) Team; development of Hazard and Safety Analysis Reports; reviewing, updating and maintaining hazard and Safety Analysis Reports; implementation of project-specific health and safety requirements; and other health and safety costs.	LS
.02.15	**CONTRACT CLOSEOUT** Phases 1 to 6 • This element includes contract closeout activities that carryover to LTS following closure of the site. These activities are associated with former operating contracts that were issued prior to site closure. Activities associated with administration of contracts issued during LTS are included in X.02.06, Procurement—Equipment and Material.	LS
.02.16	**REALTY SERVICES** Phases 1 to 6 • This element includes professional realty services associated with transfer of property from DOE to other parties. Establishment and maintenance of institutional controls in land records for transferred property is included in X.02.04, Institutional Control.	LS
.02.17	**REGULATORY AGENCY OVERSIGHT STAFF** Phase 6 • This element includes costs for direct funding of regulatory agency staff providing oversight to LTS activities.	LS/YR
.02.18	**INFORMATION MANAGEMENT** All Phases • This element contains activities associated with management of site records and other information related to the site. Level 3 elements address operation of a records management facility; management of records at an off-site archive; management of records in electronic format, including maintenance of hardware, software, and storage media; and records declassification.	LS

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.02.19	**LITIGATION SUPPORT** All Phases • This element includes costs for staff labor providing litigation support.	LS/YR
.02.9x	**OTHER** Phases 1 to 8 • This element includes project management activities not described by the above-listed subsystems.	LS
.03	**PREPARATION OF PLANS**	
.03.01	**WORKPLAN** Phase 1 to 6 • This element includes individual generic project workplans identifying the scope of work, schedule, resource requirements, execution and associated activities. See also Environmental Workplan, Element X.03.14, Decommissioning Plan at X.03.15, X.03.17 for Combined Workplan, or other elements in X.03.xx for specific plans.	EA
.03.02	**CHEMICAL DATA ACQUISITION PLAN** Phase 1 to 6 • This element includes preparing, updating, and maintaining of chemical data acquisition plans and tracing the path of the data from receipt in the field or laboratory to the use or storage of the final reported form. The plan addresses standard record-keeping procedures, document control system, and data storage and retrieval. It includes control mechanisms for detecting and correcting paperwork errors and preventing loss of data during data reduction, data reporting, and data entry to forms, reports and databases.	EA
.03.03	**SAMPLING AND ANALYSIS PLAN** Phase 1 to 6 • This element includes preparing, updating, and maintaining Sampling and Analysis Plan that describe how air, water, and soil samples will be collected and analyzed in accordance with technically acceptable protocols. The sampling and analysis plan consists of two parts: (1) a quality assurance project plan, and (2) the field sampling plan.	EA
.03.04	**HEALTH AND SAFETY PLAN** Phase 1 to 5 • This element includes preparing, updating, and maintaining health and safety plans that specify the procedures that are sufficient to protect on-site personnel and surrounding communities from the physical, chemical, or biological hazards. The plan outlines hazards, work areas and lists control procedures, air surveillance procedures, levels of protection, decontamination and emergency plans, arrangements for weather-related problems, and responsibilities for implementing the health and safety plan. Phase 8 • This element includes Health and Safety Plan developed for the site or program. Use Phases 1-5 if the plan is project specific.	EA EA
.03.05	**POLLUTION CONTROL AND MITIGATION PLAN** Phase 1 to 6 • This element includes preparing pollution control and mitigation plans developed to prevent or reduce the impact of a hazardous materials incident on people, property, and the environment. The plan addresses the following response elements: recognizing the type and degree of the hazard present; determining its effect or potential impact on public health, property, and the environment; control measures to reduce or prevent contact of people with the hazardous materials; and cleanup measures for restoring the area to pre-release conditions.	EA

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.03.06	**DATA MANAGEMENT PLAN** Phase 1 to 5 • This element includes preparing data management plans that discuss how environmental data will be managed. Environmental data include chemical, physical, risk, hydrological, geological, and economic information. The plan addresses the type of database used, software programs, sample tracking, and how the data will be analyzed and displayed.	**EA**
.03.07	**COMMUNITY RELATIONS PLAN** Phase 1 to 6 • This element includes preparing community relation plans that outline the community relations history, issues of community concern, and specific community relations activities to be undertaken during the course of a response action. The plan is designed to facilitate two-way communication between the affected community and the agencies responsible for conducting a response action.	**EA**
.03.08	**TRANSPORTATION AND DISPOSAL PLAN (ENVIRONMENTAL MANAGEMENT PLAN)** Phase 1 to 6 • This element includes preparing transportation and disposal plans that address environmental mitigation procedures for hazardous substances that are transported from the site. The plan addresses handling/transporting and disposing of hazardous materials.	**EA**
.03.09	**MANAGEMENT PLAN** Phase 1 to 5 • This element includes preparing a management plan that addresses site specific actions and schedules for implementing response actions necessary to protect human health and the environment. Phase 8 • This element includes management plans developed for the program or the site. Use Phases 1 to 6 if the plan is developed for a specific project.	**EA** **EA**
.03.10	**RISK ASSESSMENT PLAN** Phase 2 • This element includes preparing risk assessment plans. These plans provide a qualitative and quantitative evaluation of the risk posed to human health or the environment by the actual or potential presence or use of specific pollutants. The assessment includes contaminant identification, exposure assessment, toxicity assessment, and risk characterization. Phase 8 • This element includes risk assessment plans developed for the program or the site. Use Phases 1 to 6 if the plan is developed for a specific project.	**EA** **EA**
.03.11	**TECHNICAL PROJECT GOALS AND OBJECTIVES** Phase 1 to 3 • This element includes defining the scope of response actions to mitigate potential threats to human health and the environment, prevent further environmental degradation, and significantly reduce risks. This includes development of a conceptual site model, identification of data needs and data quality objectives, identification of preliminary construction/work objectives and potential alternatives, identification of treatability studies, preliminary identification of ARARs of STDs, identification of NEPA requirements, and identification of other regulatory requirements.	**LS**

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.03.12	**IMPLEMENTATION PLANS** Phase 1 to 5 • This element includes work incurred to obtain all necessary plans and permits. including QA/QC plans, workplans, shop drawings, demolition plans, environmental control plans, pollution control plans, site Safety and Health Plans, site security plan, materials handling/transportation/disposal plan and all local, state, and Federal permits.	**EA**
.03.13	**EMERGENCY RESPONSE PLANS/REPORT/APPROVAL** Phase 1 to 4 • This element includes the identification of procedures to follow in responding to a hazardous, toxic, and radioactive materials incident.	**LS**
.03.14	**ENVIRONMENTAL WORKPLAN** Phase 1 to 4 • This element includes preparing workplans required for performing environmental projects. Examples of plans are: Remedial Investigation Workplan, Remedial Design Workplan, Remedial Action Workplans, or other environmental workplans. Use element X.03.01 for more generic workplans.	**EA**
.03.15	**DECOMMISSIONING PLAN** Phase 1 to 3 • This element includes preparing decommissioning plans, which describe the method to be used to prepare to decommission a radiation contaminated facility. Also includes information on facility history, characterization, and status; alternative selection; decommissioning activities; program management; worker and environmental protection; environmental management; and final survey plan. Use element X.03.01 for generic workplans.	**EA**
.03.16	**POST RA/D&D MONITORING PLAN** Phase 4 to 6 • This element includes preparing a post RA/D&D monitoring plan to ensure the site remains safe. The plan includes discussion of final site configuration, periodic inspection and monitoring, maintenance of barriers to prevent intrusion, and prevention of activities that might impair those barriers.	**EA**
.03.17	**COMBINED WORKPLAN** Phase 1 to 6 • This element includes the preparation, maintenance, and updating of a combined workplan. A combined workplan includes workplans (e.g., sampling and analysis plan, health and safety plan, etc.) in one document. An example of a combined workplan is the RFI/RI/BRA workplan which provides information on detailed work to be performed, history of waste units and previous characterization activities, risk assessment, contaminant migration criteria, technical analysis and approach, and other related information.	**EA**
.03.18	**PROPOSED PLAN** Phase 1 to 3 • This element includes preparing a proposed plan/document that describes the preferred treatment alternative to the general public. Activities include the development of scoping packages, preparation of revision 0 document, resolution and incorporation of comments, and the preparation of revision 1 document Also, the attendance at public meetings may be included in the cost of preparing this plan.	**EA**
.03.19	**RCRA PERMIT PREPARATION/MODIFICATION** Phase 3 • Includes all activities associated with preparing or modifying RCRA permits.	**EA**

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.03.20	**ENVIRONMENTAL ACTION IMPLEMENTATION PLAN** Phase 3 and 4 • Activities associate with preparing workplan that provides a general description of the remedial action and the construction work to be performed as well as a schedule for construction and implementation of the remedial action. This report provides a description of how changes to the remedial design will be managed and how state environmental agencies and the EPA will be notified of any changes. Also included with this document are any requirements and plans for any waste disposal and transport activities that will occur as a part of the remedial action. A discussion of the actions required to close out the remedial action project (e.g., equipment startup and testing, operations and maintenance plan, as-built drawings) will also be provided.	**EA**
.03.21	**WASTE SITE WORK PERMITS** Phase 1 to 6 • This element includes all activities associated with the preparation or modification of site-required permits. Includes Site Clearance, Site Use, and Work Clearance.	**EA**
.03.22	**CORRECTIVE ACTION PLAN REPORTING** Phase 1 to 6 and 8 • Actions proposed and implemented to correct problems identified in non-conformance documents.	**EA**
.03.23	**MATERIAL DISPOSITION PLAN** Phases 4 to 6 • This element includes preparing plans for final disposition of radioactive materials and waste for which no means of final disposition is identified at the project beginning. These plans will be prepared when a means of final disposition is identified and will specify all activities leading to final disposition.	**EA**
.03.9X	**OTHER** Phases 1 to 8 • This element includes all other activities involved in preparing plans not described by the above-listed categories.	**EA**
.04	**STUDIES/DESIGN & DOCUMENTATION**	
.04.01	**HAZARDOUS, TOXIC, OR RADIOACTIVITY RANKING SYSTEM** Phase 1 to 2 • This element includes implementing the hazardous, toxic, or radioactivity ranking system (HRS). This system is the principal screening tool used by the EPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous, toxic, or radioactive contaminated sites. The HRS calculates a score based on the potential of hazardous, toxic, or radioactive substances spreading from the site through the air, surface water, or groundwater and on other factors such as density and proximity of human population. This score is the primary factor in deciding if the site should be on the National Priorities List, and if so, what ranking it should have.	**LS**
.04.02	**HUMAN HEALTH RISK ASSESSMENT** Phase 1 to 2 • This element includes the execution of a human health risk assessment. The assessment provides for the qualitative and quantitative evaluation of risk. The following items are included: hazard, toxic, and radiological identification (sources), dose-response assessment, pathway analysis, characterization of the site and potential receptors, exposure assessment, risk characterization, limitations/uncertainties, and a site conceptual model.	**LS**

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.04.03	**ECOLOGICAL RISK ASSESSMENT** Phase 1 to 2 • This element includes performing an ecological risk assessment. This assessment provides a qualitative or quantitative appraisal of the actual or potential effects of a hazardous waste site on plants and animals other than people and domesticated species. However, information from ecological studies may point to new or unexpected exposure pathways for human populations, and a health assessment may help identify environmental threats.	LS
.04.04	**RISK ASSESSMENT DOCUMENTATION** Phase 1 to 2 • This element includes preparing a baseline risk report that analyzes potential adverse health effects (current or future) caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). See also X. 04.15, Combined Report for applicability.	LS
.04.05	**REMEDIAL INVESTIGATION REPORT** Phase 1 to 2 • This element includes producing a document that presents the results of the remedial investigation (RI) or RCRA facility investigation (RFI). This activity includes drafting reports, responding to draft report comments, and finalizing the report. The report discusses site background, investigation, site characteristics, nature and extent of contamination, fate and transport, and conclusions.	EA
.04.06	**DEVELOP ENVIRONMENTAL ALTERNATIVES** Phase 2 • This element includes developing environmental alternatives that involve applying site-specific factors to candidate remediation, waste treatment or environmental treatment technologies. The activity includes establishing objectives and general response actions, identifying preliminary alternatives, identifying and screening applicable technologies, developing alternatives, identifying requirements for treatability studies, assembling technologies into actions, and developing a conceptual site model. See also X. 04.18, Combined Feasibility Document for applicability.	LS
.04.07	**SCREEN ENVIRONMENTAL ALTERNATIVES** Phase 2 • This element involves selecting applicable remedial waste treatment or environmental alternatives by applying specific criteria. See also X. 04.18, Combined Feasibility Document for applicability.	LS
.04.08	**EVALUATE ALTERNATIVES** Phase 2 • This element includes the evaluation of the treatment alternatives by comparing alternatives based on the identified criteria such as protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction in toxicity/mobility/volume, short-term effectiveness, implementability, cost, and state and community acceptance. See also X. 04.18, Combined Feasibility Document for applicability.	LS
.04.09	**REFINEMENT OF ALTERNATIVES** Phase 2 • This element involves refining environmental alternatives to maximize the goals of the action, their ability to meet the established criteria, and improve the probability that the state and community will accept the alternatives. See also X. 04.18, Combined Feasibility Document for applicability.	LS

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.04.10	**DOCUMENT FS (CMS)** Phase 2 • This element involves performing a study to identify and evaluate options for environmental projects. The Feasibility Study (FS) is generally performed concurrently and interactively with the investigation processes. Activities include drafting the FS report, responding to comments, and finalizing the report. See also X. 04.18, Combined Feasibility Document for applicability.	**LS**
.04.11	**ENVIRONMENTAL MANAGEMENT PROJECT DESIGN** Phase 3 and 4 • This element provides for preparing the preliminary, intermediate, and final design for applicable environmental projects (e.g., Underground Storage Tanks, Waste Management, or Environmental Restoration). The design stage includes developing design of the selected remedy including the preparation of detailed plans, drawings, and specifications for construction. Office-based engineering support during construction is included in Phase 3; field-based engineering support during construction is included in Phase 4.	**EA**
.04.12	**DECONTAMINATION/DISMANTLEMENT PROJECT DESIGN** Phase 3 and 4 • This element provides for decommissioning, decontamination, and dismantlement design preparation including preliminary design, intermediate design, and final design. The decommissioning, decontamination, and dismantlement design stage includes the development of the actual design of the selected remedy including the preparation of detailed plans, drawings, and specifications for decommissioning, decontamination, and dismantlement. Office-based engineering support during construction is included in Phase 3; fields-based engineering support during construction is included in Phase 4.	**EA**
.04.13	**FACILITY DESIGN** Phase 3 and 4 • This element provides for facility design preparation including preliminary design, intermediate design, and final design. The facility design stage includes the development of the actual design of the facility including the preparation of detailed plans, drawings, and specifications for the facility. Office-based engineering support during construction is included in Phase 3; fields-based engineering support during construction is included in Phase 4.	**EA**
.04.14	**VALUE ENGINEERING/SPECIAL STUDIES** Phase 3 and 4 • This element includes value engineering during design and construction. Value engineering during design is a function-oriented, multi disciplinary team approach used to eliminate unnecessary design costs without sacrificing performance or quality. It provides an effective method for defining a problem and a system for achieving the best value. Identification, classification, and analysis of functions are used to resolve a problem or determine how to meet a need. Value engineering during construction encourages the construction contractor to propose changes in construction to provide the most up-to-date construction solutions. The value engineering change proposal (VECP) is an incentive clause in the contract that provides the contractor and the Federal agency a monetary benefit. Office-based engineering support during construction is included in Phase 3; fields-based engineering support during construction is included in Phase 4.	**LS**

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.04.15	**COMBINED REPORT** Phase 1 to 6 • This element includes all efforts related to the preparation of findings during environmental investigation and related technical analyses. For example, the RFI/RI/BRA report includes a unit characterization summary, presentation of the unit data, analysis of contaminant fate and transport, human health risk assessment, ecological risk assessment, and the determination of appropriate treatment goal options. This element includes all activities required to prepare, review, revise, and approve the combined report. This element may also include the development of a scoping package, the first draft document, comment resolutions, comment incorporation, and the preparation of revision 1 documents.	EA
.04.16	**ENGINEERING EVALUATION/COST ANALYSIS REPORT** Phase 2 and 3 • This element includes preparing an engineering evaluation/cost analysis report based on-site characterization results, and contaminant of concern and concentrations. This report contains evaluation results of various treatment alternatives, and the cost for these alternatives.	EA
.04.17	**RECORD OF DECISION** Phase 2 and 3 • This element includes preparing a Record of Decision. The record of decision is the document that describes the treatment options agreed upon by EPA, state, and the responsible party. The scope of the document includes the development of scoping packages, revision 0 document preparation, comment resolution, comment incorporation and the preparation of a revision 1 document. The document may also include attendance at public meetings.	EA
.04.18	**COMBINED FEASIBILITY STUDY EFFORT** Phase 2 • This element includes elements, which combine several of the Structure Elements (i.e. X.04.06 to X.04.10) into one element.	LS
.04.19	**POST-CONSTRUCTION DESIGN REPORT** Phase 4 • This element includes preparing a post-construction design report. This document provides a general narrative of the construction activity that has been performed for the environmental project. It includes a brief discussion of unexpected conditions encountered in the field, particularly those that affected the scope or schedule of the construction work. It also identifies design changes that were required during construction and provides required certifications, verifications and as-built for the environmental project.	EA
.04.20	**TASK REQUIREMENTS AND CRITERIA** Phase 3 • Prepared in the preliminary design phase and defines the requirements and criteria for the environmental project.	LS
.04.21	**SUBMITTALS** Phase 3 and 4 • This element includes reports and documents submitted during or after completion of design and construction. Examples of submittals include punch list, project acceptance report, survey results, final Quality Assurance/Quality Control (QA/QC) reports, and as-built drawings.	EA
.04.9x	**OTHER** Phase 1 to 6 • This element includes all other activities involved in the studies/design and documentation not described by the above-listed categories.	EA

ECES #	ECES DESCRIPTION	UOM
.05	**SITE WORK**	
.05.01	**MOBILIZATION** Phase 1 to 6 • This element includes the transport of equipment, personnel, and facilities to the site, and construction of temporary facilities and utilities.	**LS**
.05.02	**CLEANUP/LANDSCAPING/REVEGETATION** Phase 1 to 6 • This element includes cleanup activities consisting of general area cleanup, removal of trash and debris, and washing or sweeping of roads and parking lots usually as a concluding activity in a project or program. This element also includes landscaping activities consisting of land preparation for, and execution of, seeding, planting, sodding, revegetation of site; slope protection; fertilization; watering; and mowing and trimming as required at the site.	**M^2**
.05.03	**CLEAR AND GRUB** Phase 1 to 4 • This element includes clearing and grubbing as necessary for preparing the site for construction, remediation, treatment, or other activities. Clearing is the process of removing vegetation such as trees, shrubs, brush, grass, and other plants. Grubbing is the removal of stumps, roots, and debris from soil by heavy equipment such as dozers, scrapers, and excavators.	**M^2**
.05.04	**DISMANTLING AND DEMOLITION** Phase 1 to 5 • This element includes demolishing or dismantling of structures and facilities such as buildings, roads, pavements, fencing, pipes, and underground utilities in a **non-hazardous area**. This activity also includes the removal of barriers and other structures. Dismantling and demolition in hazardous areas should use treatment technologies and Facility D&D activities in sections X.21.xx to X.31.xx, and X.34.xx to decontaminate the structures. See X.14.01 also for Demolition for OE Removal.	**M^2**
.05.05	**EXCAVATION AND EARTHWORK** Phase 1 to 4 • This element includes excavation necessary for site improvements; preparation for construction; installation of pipes, installation of underground utilities, treatment units and facilities; roadways; foundation; and other cut and fill requirements. This element includes removal of large rocks or excavation of various types of soils, grading, backfilling, stripping topsoil, soil compaction, and other miscellaneous activities. Methods include blasting, excavating with dragline, clamshell, or excavators. Other activities in the Site work assume excavation is not included. Therefore use this element when excavation and earthwork are necessary. It should be noted that if excavation is already included as part of other specific elements, the user should not double count by using this element again. This element does not include substructure removal under D&D. See Element X.31.17.	**M^3**
.05.06	**LOAD AND HAUL** Phase 1 to 5 • This element includes the loading and hauling of excavation cut-and-fill materials, debris and trash, stockpiled materials, and other materials that may be needed for transport to and from other locations such as disposal facilities or material plants. Also includes handling and dumping fees. Dump trucks, loaders, and haulers may be used. Other activities in the Site Work Element assume load and haul is not included. Therefore use this activity when loading and hauling are necessary.	**M^3**

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.05.07	**BORROW PIT/HAUL ROADS** Phase 1 to 4 • A borrow pit is the location to obtain fill material for earthwork that meets certain specifications. A haul road is used to transport the borrowed material to the construction site. This element includes the construction and excavation of Haul Roads and Borrow Pits where necessary.	**M^3**
.05.08	**ACCESS ROADS** Phase 1 to 4 • Access to a site is often a major concern in any project where heavy equipment must be moved or transported. This element includes construction of access roads for construction sites or other facilities when such access is not possible or does not exit. The access road can consist of one lane dirt or gravel road to more complex multi-lane asphalt and concrete systems. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repair, and maintenance of access roads during normal use after completion of construction.	**M^2** **M^2/YR**
.05.09	**ARTERIAL ROADS/DIVIDED HIGHWAYS** Phase 1 to 4 • This element includes constructing permanent arterial roads or divided highways for public or private use due to the change of traffic patterns caused by the project construction or ongoing facility operations and maintenance. Costs in this element include components such as road construction materials, barricades, equipment, guardrails, curbs and gutters, and other integral components not already included by using other elements. It is assumed that excavation/earthwork is not included in this element. If excavation/earthwork are necessary, use X.05.05, Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repair, and maintenance during normal use after completion of construction.	**M^2** **M^2/YR**
.05.10	**DIESEL GENERATOR** Phases 1 to 4 • Cost to purchaser and install diesel generators that usually provides stand-by and emergency power. Phases 5 and 6 • This element includes cost associated with operating and maintaining the diesel generator. Examples of cost includes oil and lubrication, replacing parts, inspection of system components, cleaning of area, and other operation and maintenance costs.	**EA** **EA/YR**
.05.11	**ACCESS CONTROL FACILITY** Phases 1 to 4 • Construction of a facility that controls entrance and exit of personnel, material, equipment, automobiles and other items. Phases 5 and 6 • This element includes cost associated with operating and maintaining the access control facility.	**M^2** **M^2/YR**

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.05.12	**RAILROAD TRACKS AND CROSSING** Phase 1 to 4 • This element is used when there is a need to construct railroad tracks or a crossing for the transport of materials to the site. Activities include preparation of track bed, tracks, ties, materials, markings, and other required items. Phases 5 and 6 • This element includes inspection, clearing, repair, and maintenance of the tracks and crossing.	**M** **M/YR**
.05.13	**BRIDGES** Phase 1 to 4 • This element includes the cost to construct bridges necessary for site or project construction and operations. Types of bridges include timber or wooden structures, concrete structures, iron or steel structures, or composite material structures. Phase 5 and 6 • This element includes the inspection, cleaning, clearing, repairs, and maintenance of bridges during normal use after completion of construction.	**M^2** **M^2/YR**
.05.14	**FENCING** Phase 1 to 4 • This element includes constructing various types of fencing and gates for boundary placement, security, safety, privacy, or other purposes. If minor excavation and earthwork are necessary to install the fence, the cost should be included in this element. See also Institutional Controls, X.02.04. Phases 5 and 6 • This element includes the inspection, repairs, and maintenance of fences and boundary placements during normal operations.	**M** **M/YR**
.05.15	**PARKING LOTS** Phase 1 to 4 • This element includes constructing gravel, asphalt, or concrete parking lots as needed for site/facility construction and for personnel during operations and maintenance of the facility. • See also X.05.11, Resurfacing Roadways/Parking Lots. Phases 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of parking lots during normal use after completion of the construction. This includes the placement of a new surface cover over the existing surface. This may be required due to deteriorated condition of the surface, or because of changes to the marking. Existing concrete or asphalt surfaces will be resurfaced with asphalt surfaces or concrete, and gravel surfaces will be resurfaced with gravel.	**M^2** **M^2/YR**
.05.16	**RETAINING WALL** Phase 1 to 4 • This element includes constructing retaining walls designed to hold back soil or other loose material and prevent these materials from falling or sliding. Costs in this element include the retaining wall structure components, footing, construction, and minor trenching. If major excavation and earthwork are necessary, use element X.05.05. Phases 5 and 6 • This element includes inspection, repair, and maintenance of the retaining wall.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.05.17	**SIDEWALKS** Phase 1 to 4 • This element includes constructing gravel, asphalt, brick, or reinforced concrete sidewalks for pedestrian traffic. Phase 5 and 6 • This element includes routine inspection, clearing, cleaning, repairs, and maintenance of sidewalks during normal use after the completion of construction.	**M^2** **M^2/YR**
.05.18	**SPRINKLER SYSTEM** Phase 1 to 4 • This element includes constructing sprinkler systems for landscaping irrigation or for dust suppression during construction and facility operations. This element includes piping, pumping, sprinkler heads, valves, reducers, and control system. Phase 5 and 6 • This element includes the inspection, and maintenance of sprinkler systems during normal use after completion of the construction.	**M** **M/YR**
.05.19	**STRUCTURES/CULVERTS** Phase 1 to 4 • This element includes the construction or placement of cast in place concrete pipes or barrels, or large corrugated metal pipes culverts. These culverts, usually installed under roadways, are used for storm-water collection, directing the flow of water, and for transport of runoff. This element includes piping, fittings, manholes, and other work integral to construction of structure/culverts. Major earthwork and excavations are not included in the costs for this element. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of structures and culverts during normal use after completion of the construction. This includes the placement of a new surface cover over the existing roadway for the stripped roadway. This may be required due to deteriorated condition of the surface, or because of changes to the markings. Existing concrete or asphalt surfaces will be resurfaced with asphalt or concrete, and gravel surfaces will be resurfaced with gravel.	**M** **M^2/YR**
.05.20	**GAS DISTRIBUTION** Phase 1 to 4 • This element includes the construction or placement of underground gas distribution pipelines from the main distribution to site locations. Costs in this element include pipe supports and foundation, piping, valves and switches, and other miscellaneous costs. Major excavation and earthwork are excluded from this element. Phase 5 and 6 • This element includes the inspection, repair, and maintenance of gas distribution pipelines during normal use after completion of the construction.	**M** **M/YR**

ECES #	ECES DESCRIPTION	UOM
.05.21	**FUEL LINE DISTRIBUTION** Phase 1 to 4 • This element includes the construction or placement of underground pipelines for fuels distribution (excluding gas distribution) from the distribution main to required site locations. Costs for this element include foundations/supports, switches and valves, pumps, piping, and other auxiliary components. This element does not include major excavation or earthwork. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repair, and maintenance of fuel line distribution during normal use after completion of the construction.	**M** **M/YR**
.05.22	**FUEL STORAGE TANKS** Phase 1 to 4 • This element includes the installing or constructing storage tanks for fuel during site construction or facility operation and maintenance. It also includes foundation or support for the tanks and meters and controls. This element does not include major excavation or earthwork. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repair and maintenance of fuel storage tanks during normal use after completion of the construction.	**EA** **EA/YR**
.05.23	**HEATING/COOLING DISTRIBUTION SYSTEMS** Phase 1 to 4 • This element includes the construction or installation of heating and cooling distribution systems from a central plant source to the construction site or for facility operations and maintenance. A distribution system consists of supply pipe for chilled water and a separate pipe for hot water. Also included is a separate return pipe from the site to the central plant. This element includes support frames and structures, system instrumentation and controls, valves, fittings, flow measures, and other appurtenance. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repair, and maintenance of heating and cooling distribution system during normal use after completion of the construction.	**M** **M/YR**
.05.24	**STEAM AND CONDENSATE DISTRIBUTION** Phase 1 to 4 • This element includes the construction or installation of steam and condensate distribution systems from a central plant source to the construction site or for facility operations and maintenance. Distribution systems consist of a supply pipe for steam and a separate pipe for condensate. Also included is a separate return pipe from the site to the central plant. This element includes support frames and structures, system instrumentation and controls, valves, fittings, flow measures, access ways, and other appurtenance. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repair, and maintenance of steam and condensate distribution systems during normal use after completion of the construction.	**M** **M/YR**

ECES #	ECES DESCRIPTION	UOM
.05.25	**TREATMENT PLANTS/LIFT STATIONS** Phase 1 to 4 • This element includes constructing treatment plants and lift stations used to treat and transport non-contaminated or non-hazardous fluids. This element includes water or wastewater treatment unit construction and installation, piping, valves and fittings, instrumentation and control, supporting frames and structures, and other necessary appurtenances. This element does not include excavation and earthwork. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repairs, and maintenance of the treatment plant or the lift station during normal use after completion of the construction.	**M^2** **M^2/YR**
.05.26	**WATER DISTRIBUTION** Phase 1 to 4 • This element includes the installing or constructing a system to distribute potable or irrigation water to construction sites or facilities from a central location. This element includes piping, valves and fittings, instrumentation and controls, pumps, manholes, and other required appurtenances. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of the water distribution system during normal use after completion of the construction.	**M** **M/YR**
.05.27	**WATER STORAGE TANKS** Phase 1 to 4 • This element includes the installing or constructing tanks to store potable or irrigation water for construction sites or facilities. This element includes tanks, piping, valves and fittings, instrumentation and controls, pumps, and other required appurtenances. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of water storage tanks during normal use after completion of the construction.	**EA** **EA/YR**
.05.28	**STORM SEWER** Phase 1 to 4 • This element includes the installing or constructing systems to collect, redirect, and transport storm water at the construction site or for the facility to a central treatment plant. This element includes piping, valves and fittings, instrumentation and controls, pumps, manholes, and other required appurtenances. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of storm sewers during normal use after completion of the construction.	**M** **M/YR**
.05.29	**COMMUNICATIONS** Phase 1 to 4 • This element includes the construction and installation of underground or aboveground communication systems including phones, fax, video, or e-mails. Included in the element are the installation of cables and wires, hardware, switches, conduits, and other equipment. Phase 5 and 6 • This element includes the inspection, and maintenance of communication systems during normal use after completion of the construction.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.05.30	**LIGHTING** Phase 1 to 4 • This element includes the installation or fabrication of illuminating devices at the construction site, roadways, facilities, and other areas at the site. It includes switches, light bulbs, poles, foundation, and other fixtures. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of lighting systems during normal use after completion of the construction.	**M** **M/YR**
.05.31	**OVERHEAD ELECTRICAL DISTRIBUTION** Phase 1 to 4 • This element includes the installing or constructing devices for overhead electrical distribution to construction sites or facilities from a central location. This element assumes there is no excavation for distribution line installations, but includes wires, poles, switches, transformers, and other related items. Phase 5 and 6 • This element includes the inspection, repairs, and maintenance of overhead electrical distribution during normal use after completion of the construction.	**M** **M/YR**
.05.32	**UNDERGROUND ELECTRICAL DISTRIBUTION** Phase 1 to 4 • This element includes the installing or constructing buried electrical power distribution enclosures, wires, cables, switches, fixtures, transformers, and other appurtenances from a central location to a construction site or to a facility. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, repairs, and maintenance of underground electrical distribution systems during normal use after completion of the construction.	**M** **M/YR**
.05.33	**SANITARY SEWER** Phase 1 to 4 • This element includes installation and construction of systems to collect and transport aqueous sanitary waste to a central treatment location from a construction site or a facility. Items include piping, pumps, instrumentation and control, valves and fittings, storage tanks, and other necessary appurtenances. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of sanitary sewers during normal use after completion of the construction.	**M** **M/YR**
.05.34	**RESTORATION OF BUILDINGS AFTER D&D** Phase 4 to 6 • This element includes restoration of buildings and facilities for reuse after D&D.	**M^3**

ECES #	ECES DESCRIPTION	UOM
.05.35	**COMPRESSED AIR/NITROGEN** Phases 1 to 4 • This element includes installing and constructing systems to supply compressed air and nitrogen. Items include piping, compressors, instrumentation and control, valves and fittings, storage tanks, and other necessary appurtenances. Use X.05.05 to account for Excavation and Earthwork. Phase 5 and 6 • This element includes the inspection, clearing, cleaning, repairs, and maintenance of compressed air and nitrogen system during normal use after completion of the construction.	**M^3** **M^3/YR**
.05.36	**DEMOBILIZATION** Phase 1 to 6 • This element includes the transportation of equipment back to owner and personnel back to their permanent place of residence. This element provides for all work associated with plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel.	**LS**
.05.37	**POPULATION RELOCATION** Phase 1 to 6 • This element includes the relocation of residents or users during a project due to the contamination of a site or potential risk posed to the citizens. Phase 8 • This element includes the relocation of residents to reduce the risk of exposure or potential for contamination due to site- wide or base-wide activities.	**EA** **EA**
.05.38	**RELOCATION OF DISTRIBUTION SYSTEMS** Phase 1 to 4 • This element includes costs associated with relocation of distribution systems such as gas, fuel, water, communications, and electrical. This task may include removal of old distribution systems and installation and connection of new systems. Excavation to install the distribution systems in included in this element. See also elements X.05.04 and X.05.36 to ensure that cost have not been duplicated. Phase 5 and 6 • Operation, inspection, maintenance, repair, and cleaning and clearing the underground electrical distribution system during normal use.	**M** **M/YR**
.05.39	**STEAM PLANT FACILITY** Phases 1 to 4 • Constructing a facility that produces the steam requirements for each of the major facilities. The steam plant facility includes the steam plant building, the boiler fuel oil day tank area adjacent to the steam plant building, and a condensate return to the boiler. Phases 5 and 6 • This element includes cost associated with operating and maintaining the steam plant facility and associated equipment. Example of cost includes operation of steam plants, replacing parts, regular inspection of system components, cleaning of area, and other operation and maintenance costs.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.05.40	**SWITCH GEAR BUILDING** Phases 1 to 4 • Constructing a facility that distributes incoming power from the DOE substation to all site facilities. Phase 5 and 6 • This element includes cost associated with operating and maintaining the switch gear building. Example of costs includes operating the facility, replacing parts, regularly inspecting system components, cleaning of area, and other operation and maintenance costs.	**M^2** **M^2/YR**
.05.41	**IMPORTANT TO SAFETY SWITCH GEAR BUILDING** Phases 1 to 4 • Constructing a facility that distributes incoming power from the diesel generators to important to safety systems Phases 5 and 6 • This element includes costs associated with operating and maintaining the switch gear building. Example of costs includes operating the facility, replacing parts, regularly inspecting system components, cleaning of area, and other operation and maintenance activities.	**M^2** **M^2/YR**
.05.51	**GENERAL REQUIREMENTS** Phase 1 to 6 • This element includes work and costs associated with initial set-up and final closeout of the site such as mobilization and demobilization, and temporary construction of roads and fencing to access and secure the site.	**LS**
.05.52	**CLEAN SITE WORK** Phase 1 to 6 • This element includes activities such as initial site visit and preparations; excavation and earthwork; loading, hauling, and dumping; clearing and grubbing; paving and surfacing; bridges and railroads; providing for piped utilities, sewage and drainage; and landscaping.	**LS**
.05.53	**CONCRETE** Phase 1 to 6 • This element includes work associated with placing concrete such as formwork, reinforcement, cast-in- place concrete, and transporting and installing precast concrete.	**M^3**
.05.54	**MASONARY** Phase 1 to 6 • Material, labor, and equipment costs associated with installing various types of masonry units such as bricks, blocks, stones, ties, reinforcing, scaffolding, sand blasting, cleaning, and performing other masonry tasks.	**M^2**
.05.55	**METALS** Phase 1 to 6 • Costs associated with installing or constructing metal components in buildings and structures. Examples of cost components include metal specialties such as: fasteners, metal framing, structural steel and aluminum, metal joists, metal decking, stairs, ladders, rails, floor plates and grating, and metal roping.	**KG**

ECES #	ECES DESCRIPTION	UOM
.05.56	**WOOD & PLASTICS** Phase 1 to 6 • Costs associated with installing wood or plastic buildings and structures. Examples of wood cost components include: fasteners and adhesives, wood framing, columns and other structural supports, roofs, sheathing, flooring, decking, millwork molding, shelving, plastic laminate, paneling, finish carpentry, preservation and treatment, stairs and handrails, cabinets. Examples of cost associated with plastics include fiberglass columns and rails, grating, and vanity and counter tops.	**LS**
.05.57	**THERMAL AND MOISTURE PROTECTION** Phase 1 to 6 • Costs associated with installing thermal and moisture protection such as waterproofing and damp proofing; insulation and fireproofing; shingles, roofing, and siding; membrane roofing; flashing and sheet metals; skylights; and joint sealers.	**M^2**
.05.58	**DOORS AND WINDOWS** Phase 1 to 6 • This element includes cost associated with metal, wood, glass, and plastic doors, frames, and windows. This element also include miscellaneous costs such as hinges, glazing, screens, locks, doorstops, bumpers, and similar items.	**EA**
.05.59	**FINISHES** Phase 1 to 6 • This element is associated with finishing buildings and rooms and installing aesthetic features. Examples of costs include: lathing, plastering, and boarding; flooring and carpeting; interior painting, wall papers, and wall coverings; tiling and terrazzo; ceilings; trims; exterior painting; and other finishing work.	**M^2**
.05.60	**SPECIALITIES** Phase 1 to 6 • This element includes costs of specialty items for facilities such as visual display boards, bathroom partitions and compartments, bath accessories, prefabricated fireplaces, stoves, flagpole, lockers, fire protection equipment, and other specialty items.	**EA**
.05.61	**EQUIPMENT** Phase 1 to 6 • This element includes costs for equipment and building features such as vaults, bullet-resistant windows, church alters, seating, surveillance equipment, movie screens and projectors, stage equipment, curtains, laundry and dry cleaning equipment, cash registers, food services equipment and appliances, health club equipment, laboratory equipment, shop equipment, and medical equipment.	**EA**
.05.62	**FURNISHINGS** Phase 1 to 6 • This element includes cost of furnishing for offices, buildings, or facilities. Examples of furnishing include blinds or shades, display cases, cabinets, furniture, interior plants, and other furnishing items.	**EA**
.05.63	**SPECIAL CONSTRUCTION** Phase 1 to 6 • This element include constructing special facilities such as gymnasiums, greenhouses, darkrooms, clean rooms, pre-engineered buildings, underground and above-ground storage tanks, swimming pools and enclosures, air control towers, ice rinks, and other specialty facilities.	**M^2**

ECES #	ECES DESCRIPTION	UOM
.05.64	**CONVEYING SYSTEMS** Phase 1 to 6 • This element includes items such as elevators, escalators, lifts, hoists, cranes, moving walks, dumbwaiters, and other systems to convey people, material, and equipment from one location to another.	**EA**
.05.65	**MECHANICAL** Phase 1 to 6 • This element covers costs associated with pipes and fittings; conduits and ducts; plumbing fixtures; pumps; water appliances; fire protection; heating, air conditioning and ventilation; and other mechanical equipment.	**LS**
.05.66	**ELECTRICAL** Phase 1 to 6 • This element covers costs associated with power distribution, lighting, conductors and grounding, electrical boxes and wiring, controls, motors, starters, boards, switches, transformers, bust ducts, and other electrical specialty and miscellaneous items.	**LS**
.05.9x	**OTHER** Phases 1 to 6 • Other activities associated with clean site work.	**LS**
.06	**SURVEILLANCE & MAINTENANCE**	
.06.01	**FACILITY TRANSITION** Phase 1 to 6 and 8 • This element includes planning for acceptance criteria and end-point development and for end-point criteria verification.	**LS**
.06.02	**OUTDOOR SURVEILLANCE & MAINTENANCE** Phase 1 to 6 and 8 • This element includes activities required to manage inactive waste sites to minimize the spread of surface soil contamination and to comply with regulatory requirements.	**M^2/YR**
.06.03	**INDOOR SURVEILLANCE & MAINTENANCE** Phase 1 to 6 and 8 • This element includes activities to minimize the risks to the environment and human health and safety posed by the radiological and hazardous materials inventory.	**M^2/YR**
.06.9x	**OTHER** Phases 1 to 6 • Perform other surveillance and maintenance activities.	**M^2/YR**
.07	**INVESTIGATIONS & MONITORING/SAMPLE COLLECTION**	
.07.01	**SITE RECONNAISSANCE** Phase 1 to 4 • This element includes the general survey of a site to determine the situation or condition of the area. Activities include ecological resources reconnaissance, well inventory and sampling, land survey, topographic mapping, field screening, and historical investigation of the site.	**M^2**
.07.02	**METEOROLOGICAL MONITORING** Phase 1 to 6 • This element includes measurement of wind, precipitation, barometric pressure and other meteorological parameters. The element also includes procuring equipment; constructing monitoring stations; and the installing, setting up, testing, operating and maintaining meteorological stations and instrument shelters.	**EA**

ECES #	ECES DESCRIPTION	UOM
.07.03	**SITE CONTAMINANT SURVEYS/RADIATION MONITORING** Phase 1 to 6 • This element involves site contaminant surveys and radiation monitoring. Site contaminant surveys include determining the level of radiation or contamination present at the site or at a certain location. Radiation monitoring includes the measuring of radiation or personal body count levels and at specified site areas. Body count monitoring includes personal dosimetry systems, hand or foot counters and whole body counters. Area monitoring includes remote monitoring, alarm systems, survey monitoring, and special case area monitoring. Also, the construction of the monitoring station and purchase and installation of equipment and material are included as part of site contaminant survey/radiation monitoring.	**EA**
.07.04	**HYDROGEOLOGICAL INVESTIGATIONS—GROUNDWATER** Phase 1 to 6 • This element includes the investigation of site hydrogeological characteristics such as gradient, depth and size of the water table, permeability or porosity, flow direction, well drawdown, and related activities. Mechanisms for investigation include hydro punch, tidal influence studies, pump tests, and groundwater elevation measurements. The purchase and installation of equipment and material are also included in this element.	**M^2**
.07.05	**HYDROGEOLOGICAL INVESTIGATIONS — SURFACE WATER** Phase 1 to 6 • This element includes the investigation of the site hydrogeological characteristics such as flow, velocity, depth and size of the water body, flow direction, water source, and related activities. Mechanisms for investigation include tidal influence studies, elevation measurements, field surveys, and other tests. The purchase and installation of equipment and material are also included as part of this element.	**M^2**
.07.06	**GEOPHYSICAL /GEOTECHNICAL INVESTIGATION** Phase 1 to 6 • This element includes investigation of surface and subsurface geological characteristics such as mineral, biological, organic composition of soil, soil moisture content, permeability, porosity, geological formations, soil conductivity, soil pressure, shear strength, soil classification, retardation or contaminant sorption capacity, and other physical properties of the soil. Activities include drilling, remote sensor surveys, review of site history, soil testing, seismic studies, and other techniques.	**M^2**
.07.07	**ECOLOGICAL INVESTIGATION** Phase 1 to 6 • This element includes ecological investigation activities such as wetland and habitat delineation, wildlife observation, wildlife and habitat community characterization, identification of endangered species, other related activities to establish baseline conditions and to determine actions needed to reduce environmental and ecological impact during construction and facility operations.	**M^2**
.07.08	**AIR MONITORING AND SAMPLING** Phase 1 to 6 • This element includes air monitoring and sampling for detection of hazardous, toxic, and radioactive contaminants to ensure compliance with clean air regulations. This element includes monitoring of asbestos; hazardous, toxic, and radioactive contaminants; and contaminated dust, gases, and vapors. See Asbestos Abatement (X.15.04) for air monitoring during asbestos abatement. Construction of the monitoring station and installation of hardware are included as part of air monitoring and sampling cost.	**EA**

ECES #	ECES DESCRIPTION	UOM
.07.09	**GROUNDWATER SAMPLING/MONITORING** Phase 1 to 6 • This element includes sampling and monitoring groundwater to detect hazardous, toxic, and radioactive contaminants to ensure compliance with local, state, and Federal regulations. Costs for collecting routine samples and constructing the monitoring station are also included in this element.	**EA**
.07.10	**SURFACE WATER SAMPLING** Phase 1 to 6 • This element includes sampling and monitoring surface water to detect hazardous, toxic, and radioactive contaminants to ensure compliance with local, state, and Federal regulations. Costs for collecting routine samples and constructing the monitoring station are associated with this activity.	**EA**
.07.11	**SOIL/SEDIMENT SAMPLING** Phase 1 to 6 • This element includes sampling soil and sediments to detect hazardous, toxic, and radioactive contaminants to ensure compliance with local, state, and Federal regulations. Costs for collecting routine samples and constructing bore holes, drilling, and similar tasks are included in this element if the costs are not captured in Element X.07.06, Geophysical/Geotechnical Investigation.	**EA**
.07.12	**ECOLOGICAL SAMPLING** Phase 1 to 6 • This element includes sampling of habitat or biota surrounding the construction site or the facility to ensure that hazardous, toxic, and radioactive contaminants have not affected a species (such as causing changes to food supply, growth, reproduction, population, or other factors). This element also includes the cost of labor, equipment, and material required to obtain the samples.	**EA**
.07.13	**MATERIAL/WASTE SAMPLING** Phase 1 to 6 • This element includes material/waste sampling. Material/waste sampling includes work associated with the retrieval of liquid, solid, sludge, and gas waste samples to determine the presence of hazardous, toxic, and radioactive contaminants. This element also includes sampling of leachate, residues, and treatment process effluents. Costs include the construction of monitoring and sampling stations and the cost of labor, equipment and material required to obtain the samples.	**EA**
.07.14	**CONTAMINATED BUILIDING/STRUCTURES/EQUIPMENT SAMPLES** Phase 1 to 6 • This element includes sampling equipment, furniture, building walls, and other structures for the presence of hazardous, toxic, and radioactive contaminants.	**EA**
.07.15	**MONITORING WELL** Phase 1 to 4 • This element includes the drilling, installing, and constructing monitoring wells needed during Phases 1 to 4. Costs also include tremmie pipe, casing, grouting, screening, filter pack, bentonite pellets, and other components essential for the monitoring well. Phase 5 and 6 • This element includes the maintenance and operation of monitoring wells, including well inspections and repairs, clearing of areas, ensuring integrity, and performing other activities. This element does not include taking samples at monitoring wells. See X.07.09 for this cost.	**EA** **EA/YR**

ECES #	ECES DESCRIPTION	UOM
.07.16	**CONSTRUCT SITE-SPECIFIC GEOGRAPHICAL INFORMATION SYSTEM (GIS)** Phase 1 to 6 • This element includes developing a GIS system to assist in characterizing and investigating a site.	**EA**
.07.17	**HISTORICAL/CULTURAL/ARCHEOLOGICAL INVESTIGATION** Phase 1 to 6 • Obtaining, collecting, and reviewing of records and data to determine and identify if the proposed project will have impact on historical, cultural, or archeological investigation.	**LS**
.07.9X	**OTHER** Phases 1 to 6 • Other activities associated with investigation, monitoring, and sample collection.	**EA**
.08	**SAMPLE ANALYSIS**	
.08.01	**AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing air and gas samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.02	**GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing water samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.03	**SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing surface water samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.04	**SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing soil and sediment samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.05	**GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing gaseous waste samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**

ECES #	ECES DESCRIPTION	UOM
.08.06	**LIQUID MATERIAL/WASTE SAMPLING** Phase 1 to 6 • This element includes analyzing aqueous samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.07	**SOLID MATERIAL/WASTE SAMPLING** Phase 1 to 6 • This element includes analyzing solid material/waste samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.08	**BIOTA SAMPLE ANALYSIS** Phase 1 to 6 • This element includes the analyzing fauna and flora samples for hazardous, toxic, and radioactive contaminants and concentration levels. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA-certified laboratory (see X.09.01). For on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management.	**EA**
.08.09	**BIOASSAY SAMPLE ANALYSIS** Phase 1 to 6 • This element include analyzing samples to determine retention and internal depositions of hazardous, toxic, and radioactive contaminants in humans or animals.	**EA**
.08.10	**BIOACCUMULATION STUDIES** Phase 1 to 6 • This element includes executing bioaccumulation studies. Bioaccumulation is the accumulation of a substance, such as a toxic chemical, in tissues of living organisms. Bioaccumulation studies analyze the presence of contaminants and their concentrations in organisms, and how these contaminants affect the organism.	**EA**
.08.11	**MOBILE—AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing air and gas samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.12	**MOBILE—GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing groundwater samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**

ECES #	ECES DESCRIPTION	UOM
.08.13	**MOBILE—SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing surface water samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.14	**MOBILE—SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing soil and sediment samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.15	**MOBILE—GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing gas waste samples for hazardous, toxic, and radioactive contaminants and concentration levels using the mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought to the site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.16	**MOBILE —LIQUID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing liquid waste samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.17	**MOBILE—SOLID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing solid waste samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.18	**MOBILE—BIOTA SAMPLE ANALYSIS** Phase 1 to 6 • This element includes analyzing flora and fauna samples for hazardous, toxic, and radioactive contaminants and concentration levels using a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on-site, near the sampling location. A mobile unit allows sample analysis to be completed with a very short turnaround time.	**EA**
.08.19	**REAL TIME—AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of air and gas samples for hazardous, toxic, and radioactive contaminants and concentration levels suing a portable, hand held, or stationary analyzer such as Flame Ionization Detector, Photon Ionization Detector, portable gas chromatograph or other system that can analyze for the presence and amount of contaminants immediately or within a few minutes.	**EA**

ECES #	ECES DESCRIPTION	UOM
.08.20	**REAL TIME—GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of groundwater samples for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such as pH meter, conductivity sensor, thermometer, or contaminant test kit to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.21	**REAL TIME—SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of surface water samples for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such pH meter, thermometer, flow meter, fluorescence analyzer, or other assay and test kit to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.22	**REAL TIME—SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of soil/sediment sample for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such pH meter, thermometer, fluorescence analyzer, or other assay and test kit to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.23	**REAL TIME—GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of waste gas samples for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such as Flame Ionization Detector, Photon Ionization Detector, portable gas chromatograph or other system to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.24	**REAL TIME—LIQUID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of liquid waste samples for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such pH meter, thermometer, conductivity probe, fluorescence analyzer, or other assay and test kits to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.25	**REAL TIME—SOLID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • This element includes real-time analysis of solid waste sample for hazardous, toxic, and radioactive contaminants and concentration levels using a portable, hand held, or stationary analyzer such a Geiger counter, thermometer, fluorescence analyzer, or other assay and test kit can be used to determine the contaminants and concentrations immediately or within a few minutes.	**EA**
.08.9x	**OTHER** Phases 1 to 6 • This element includes other sample monitoring activities.	**EA**
.09	**SAMPLE MANAGEMENT/DATA VALIDATION/DATA EVALUATION**	
.09.01	**PREPARE AND SHIP ENVIRONMENTAL SAMPLES** Phase 1 to 6 • This element includes preserving samples; handling and packaging samples; completing chain of custody form for transport; delivering or transporting samples to analytical laboratory; and performing related.	**LS**

ECES #	ECES DESCRIPTION	UOM
.09.02	**COORDINATE WITH SAMPLE MANAGEMENT PERSONNEL/REGULATORS** Phase 1 to 6 • This element includes the coordination of the sampling process with management, regulators, and other personnel to ensure that duplicative efforts are not being performed and appropriate activities are being conducted.	LS
.09.03	**IMPLEMENT EPA-APPROVED LABORATORY QA PROGRAM** Phase 1 to 6 • This element includes the implementation of the total QA program designed to ensure the reliability of samples and their analytical results.	LS
.09.04	**PROVIDE SAMPLE MANAGEMENT** Phase 1 to 6 • This element provides for storing, tracking, and managing samples. It includes administrative management of sampling personnel, ensuring that personnel adhere to QA/QC procedures, ensuring the receipt and delivery of samples for analysis, receiving sample analysis results, and other sample management functions.	LS
.09.05	**DERIVED WASTE DISPOSAL (GAS, LIQUID, SOLID)** Phase 1 to 6 • This element involves the disposal of waste derived from the sampling and analysis processes. See also disposal facilities and disposal fees associated with disposal facilities in X.13.xx and X.13.18. Commercial disposal of waste under X.33.xx.	M^3
.09.06	**PERFORM DATA VALIDATION** Phase 1 to 6 • This element involves activities supporting data validation. It is performed after samples have been analyzed. After analysis results have been received, the data, sampling, and the analysis process need to be reviewed to ensure that the analysis is valid. If the results are determined to be invalid, the data will be thrown out. Activities might include performing statistical analysis and reviewing outlying data. Written documentation of the validation process is also included.	LS
09.07	**DATA USABILITY EVALUATION/FIELD QA/QC** Phase 1 to 6 • This element includes the evaluation of the site investigation, sampling analysis, and monitoring data to determine if the data can be used. It is accomplished by ensuring that all QA/QC procedures were followed in all the processes and by determining the relevancy of the data collected for use in technology selection and other project and program plans. Equipment calibration and maintenance are also included in this task.	LS
09.08	**DATA REDUCTION, TABULATION AND EVALUATION/ANALYSIS** Phase 1 to 6 • This element includes eliminating invalidated data, irrelevant data, or data that are statistically out of the acceptable range. After the data have been evaluated and reduced, the results will be tabulated and analyzed.	LS
.09.09	**MODELING** Phase 1 to 6 • This element involves developing, implementing the computer model for surface and groundwater flow, transportation, retardation, and other relevant characteristics of the contaminant fate. Developing the model is based on information available from literature searches, site investigations, sampling data, and bench-scale studies.	LS
.09.10	**DOCUMENT DATA EVALUATION** Phase 1 to 6 • This element involves the documenting and developing the data evaluation process.	LS

ECES #	ECES DESCRIPTION	UOM
.09.11	**COMBINED SAMPLE MANAGEMENT** Phase 1 to 6 • This element combines elements X.09.01 Prepare and Ship Environmental Samples, X.09.02 Coordinate with Sample MGT Personnel/Regulators, and X.09.04 Provide Sample Management when performed as a single function.	**LS**
.09.12	**COMBINED DATA MANAGEMENT** Phase 1 to 6 • This element combines data management elements X.09.06 Perform Data Validation; X.09.07 Data Usability Evaluation/Field QA/QC; X.09.08 Data Reduction, Tabulation and Evaluation/Analysis when performed as a single function.	**LS**
.09.13	**DATA REVIEW FOR EFFECTIVENESS** Phase 4 and 5 • Evaluate/review data to determine the performance of the remediation/treatment method (e.g., Pump & Treat).	**LS**
.09.9x	**OTHER** Phases 4 and 5 • Other activities and costs associated with sample management, data validation, and data evaluation.	**LS**
.10	**TREATABILITY/RESEARCH AND DEVELOPMENT**	
.10.01	**LITERATURE SEARCH** Phase 2 and 3 • This element includes research and review of journal articles, books, reports, and other documents to determine relevant and applicable technologies for the site and for the contaminant to be treated.	**LS**
.10.02	**DATA COLLECTION** Phase 2 and 3 • This element includes the collecting essential site, chemical, thermal, technology, and other data for further screening of technology alternatives found from the literature search. The data also will be used for planning and preparing bench-scale or pilot testing.	**LS**
.10.03	**DEVELOP TREATABILITY WORKPLAN** Phase 2 and 3 • This element includes the development and preparation of the workplan for the treatability process. It includes determining the amount and size of materials, necessary equipment, additional information to be collected from the bench- scale testing, cost and schedule estimates, process for implementing the treatability study, and related procedures.	**LS**
.10.04	**DESIGN/PROCURE NEW EQUIPMENT** Phase 2 and 3 • This element includes developing the detailed design and operating procedures for the bench-scale, pilot-scale, and field-demonstration test of equipment, processes, or materials unavailable commercially.	**LS**
.10.05	**BENCH TEST** Phase 2 and 3 • This element includes bench testing technologies and processes. It is normally performed in a laboratory, and surrogate materials may be used. The purpose is to obtain enough data on chemistry, kinetics or reaction rates, material balances, heat transfer rates, and other relevant factors to use to design and select equipment and to develop initial cost and schedule estimates. The purpose of the bench test is to determine the ability of a technology or process to treat waste.	**LS**

ECES #	ECES DESCRIPTION	UOM
.10.06	**PILOT-SCALE TEST** Phase 2 and 3 • This element includes pilot testing technologies and processes, usually at a smaller scale than the full-scale plant. It entails permitting, construction, testing, and operation of the pilot plant to evaluate performance data and to obtain more information on the construction and operation of the full-scale plant. See X.04.11, Environmental Management Project Design for design of equipment and system design. The purpose of the pilot scale test is to determine the ability of a technology or process to treat waste and to confirm bench test results.	**LS**
.10.07	**FIELD TEST** Phase 2 and 3 • This element includes demonstrating technologies and processes at a contaminated site or facility, using actual waste. It includes permitting, constructing, and operating the plant or technology. See X.04.11 Environmental Management Project Design for design of project equipment and system design. The purpose of the field test is to determine the ability of a technology or process to treat waste and to confirm pilot-scale test results.	**LS**
.10.08	**TEST SPECIAL TOOLS AND EQUIPMENT** Phase 2 and 3 • This element includes testing special tools and equipment before their final installation and use. Testing can be performed at testing facilities or laboratories. This element includes data collection relating to strength and durability, suitability to the proposed use, and efficiency and performance of the tools and equipment.	**LS**
.10.09	**DESIGN, PROCURE, TEST NEW PROCEDURES/SPECIFICATIONS** Phases 2 and 3 • This element includes developing and testing new procedures or new or improved methods of performing tasks and operations that can increase efficiency, minimize cost, increase safety, minimize waste, or provide other benefits.	**LS**
.10.10	**SIMULATION/MODELING** Phase 2 and 3 • This element includes developing or using simulators to test materials and equipment or to simulate the operation of equipment or facility. Computer programs can also be developed to model the construction and operation of equipment, technology, or a facility.	**LS**
.10.11	**DOCUMENT TREATABILITY STUDY** Phase 2 and 3 • This element includes documenting the applicability of specific treatment technologies and results of treatability studies and research and development studies.	**LS**
.10.12	**STATUS REVIEW** Phase 2 and 3 • Costs associated with reviewing technologies and comparing them to an innovative technology for performance, cost, reliability, waste generation, safety, and other factors.	**LS**
.10.13	**TECHNOLOGY TRANSFER** Phases 2 and 3 • This element captures costs associated with transferring technology from research and testing stages to implementation and commercial application.	**LS**
.10.14	**PRODUCT QUALIFICATION, CHARACTERIZATION, AND CERTIFICATION** Phase 2 and 3 • Costs associated with qualification, characterization, and certification of the innovative technology, product, or system.	**LS**
.10.9x	**OTHER** Phase 2 and 3 • Other costs associated with performing treatability research and development.	**LS**

ECES #	ECES DESCRIPTION	UOM
.11	**TREATMENT PLANT/FACILITY/PROCESS**	
.11.01	**COVERED TREATMENT TRAIN TECHNOLOGIES UNIT** Phase 4 • Construction of treatment train that contains multiple technologies and also includes rain covers, foundations and utilities. Phase 5 • Operations and maintenance of the covered treatment train unit.	**M^2** **M^2/YR**
.11.02	**SHEDS & OTHER SUPPORTING FACILITIES** Phase 4 • This element provides for constructing permanent facilities including sheds, covers, and other facilities not included in the environmental management facility but that are required to support environmental management activities. Phase 5 • This element provides for the operation (e.g., receiving, loading, and unloading) and maintenance of those facilities during the environmental management operations.	**M^2** **M^2/YR**
.11.03	**SIMPLE TREATMENT FACILITIES (e.g., EQUIPMENT SLABS, FOUNDATIONS, UTILITIES)** Phase 4 • This element provides for constructing permanent facilities including equipment pads and utilities for a simple treatment, such as ozonation. This element is not intended to provide for larger treatment trains requiring rain covers (see Element X.11.04 for that type of facility). Phase 5 • This element provides for the operations of the associated utilities and maintenance of these facilities.	**M^2** **M^2/YR**
.11.04	**TREATMENT TRAIN FACILITY (e.g., RAIN COVERS, FOUNDATIONS, UTILITIES)** Phase 4 • This element provides for constructing permanent facilities including rain covers, other structures, and utilities for treatment trains (a series of treatment technologies employed in one location) in the field. Phase 5 • This element provides for the operations and maintenance of the facility where the operator or maintenance mechanic is not performing a task specifically identifiable to a treatment technology. For example, the recharge of the Ion Exchange unit will be included in Element X.24.07. This element also includes the operation and maintenance of associated utilities and facilities during the remedial action.	**M^2** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.11.05	**FULL-SCALE ENVIRONMENTAL MANAGEMENT PLANT/FACILITY** Phase 4 • This element provides for constructing the entire environmental management facility with the exception of the functional space areas included in Elements X.11.06 through X.11.11 or the technology specific equipment found in Elements X.21.xx to X.30.xx and X.34.xx. Phase 5 • This element provides for the operation and maintenance of a facility where the operator or maintenance mechanic is not performing a task specifically identifiable to a treatment technology. The operations and maintenance of a technology housed in the functional area will normally be included in the appropriate technology-specific Elements X.21.xx to X.30.xx and X.34.xx. This element also includes the operation and maintenance of associated utilities and facilities during remedial action, waste management, or other environmental projects.	**M^2** **M^3/YR**
.11.06	**ENVIRONMENTAL MANAGEMENT LOW/MODERATE HAZARD TREATMENT FRONT-END** Phase 4 • This element provides for constructing permanent facilities for receiving and inspection, container handling, open/dump/sort, and preparation of low/moderate hazardous waste streams for treatment. Low/moderate hazardous waste streams are those waste streams exclusively regulated under 40 CFR Part 261 and that require minimal health and safety personnel protection (PPE Level C or lower). Phase 5 • This element provides for the operation and maintenance of the facility for receiving and inspection, container handling, open/dump/sort, and preparation of low/moderate hazardous waste streams for treatment. It also includes the operation and maintenance of associated utilities and facilities during the environmental management operations.	**M^2** **M^3/YR**
.11.07	**ENVIRONMENTAL MANAGEMENT HIGH HAZARD/REMOTE TREATMENT FRONT-END** Phase 4 • This element provides for constructing permanent facilities for receiving and inspection, container-handling, open/dump/sort, and preparation of high hazardous waste and remote-handled waste streams for treatment. Highly hazardous or remote-handled wastes are those waste streams that are not exclusively regulated under 40 CFR Part 261 or that require high levels of personnel protection (PPE Level B or higher), engineering controls, personnel exposure monitoring, or other safeguard. Phase 5 • This element provides for the operation and maintenance of the facilities for receiving and inspection, container handling, open/dump/sort, and preparation of high hazardous waste and remote-handled waste streams for treatment. It also includes operation and maintenance of associated utilities and facilities during the environmental management operations.	**M^2** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.11.08	**ENVIRONMENTAL MANAGEMENT LOW HAZARD FUNCTIONAL AREA** Phase 4 • This element provides for constructing the functional space area of permanent facilities dealing with the treatment of low hazardous waste streams (e.g., typical hazardous materials not requiring respirators, PPE Level D). Phase 5 • This element provides for the operation and maintenance of the functional space area of permanent facilities for the treatment of low hazardous waste streams (e.g., typical hazardous materials not requiring respirators). This element provides for the operation of the facility where the operator or maintenance mechanic is not performing a task specifically identifiable to a treatment technology. The operations and maintenance of a technology housed in the functional area will normally be included in the appropriate technology-specific Elements X.21.xx to X.30.xx and X.34.xx. This element also includes operation and maintenance of associated utilities and facilities during the environmental management process.	**M^2** **M^3/YR**
.11.09	**ENVIRONMENTAL MANAGEMENT MODERATE HAZARD FUNCTIONAL AREA** Phase 4 • This element provides for constructing functional space area of permanent facilities for treating moderate hazardous waste stream. Those waste streams exclusively regulated by 40 CFR Part 261 and require minimal health and safety personnel protection (PPE Level C). Phase 5 • This element provides for the processing of the waste stream and operation of functional areas of permanent facilities for the treatment of moderate hazardous waste streams. This element provides for the operation and maintenance of the space housing a technology application. The operations and maintenance of a technology housed in the functional area will normally be included in the appropriate technology specific Elements X.21.xx—X.30.xx and X.34.xx. This element also includes operation and maintenance of associated utilities and facilities during environmental management operation.	**M^2** **M^3/YR**
.11.10	**ENVIRONMENTAL MANAGEMENT HIGH HAZARD FUNCTIONAL AREA** Phase 4 • This element provides for constructing the functional space area of permanent facilities dealing with the treatment of high hazardous waste streams (e.g., wastes including high-level radioactive waste and mixed waste). Highly hazardous wastes are those waste streams that are not exclusively regulated under 40 CFR Part 261 or that require high levels of personnel protection (PPE Level B or higher), engineering controls, personnel exposure monitoring, or other safeguards. Phase 5 • This element provides for the of the high hazardous waste stream and operation of the functional space area of permanent facilities dealing with the treatment of high hazardous waste streams (e.g., wastes including high-level radioactive waste and mixed waste). This element provides for the operation of the facility where the operator or maintenance mechanic is not performing a task specifically identifiable to a treatment technology. The operations and maintenance of a technology housed in the functional area will normally be included in the appropriate technology-specific Elements X.21.xx to X.30.xx and X.34.xx. This element also includes operation and maintenance of associated utilities and facilities during the environmental management operation.	**M^2** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.11.11	**ENVIRONMENTAL MANAGEMENT REMOTE FUNCTIONAL AREA** Phase 4 • This element provides for constructing the functional space area of permanent facilities for the treatment of high hazardous waste streams (e.g., wastes including high-level radioactive waste and alpha-contaminated waste) requiring remote handling. Phase 5 • This element provides for processing the high hazardous waste stream and operation of functional space area of permanent facilities for the treatment of high hazardous waste streams (e.g., wastes including high-level radioactive waste and alpha-contaminated waste) requiring remote handling. This element provides for the operation of the facility where the operator or maintenance mechanic is not performing a task specific to a treatment technology. The operation and maintenance of a technology housed in the functional area will normally be included in the appropriate technology-specific Elements X.21.xx to X.30.xx and X.34.xx. This element also includes operation and maintenance of associated utilities and facilities during the environmental management process.	**M^2** **M^3/YR**
.11.12	**WASTE TREATMENT FEES AND TAXES** Phase 4 to 5 • Cost of fees and taxes charged by one Government agency to another or fees charged by one organization to another for treatment of HTR waste. This element is primarily used for capturing waste management costs. See Element X.32.xx for various disposal options applicable to some environmental restoration programs.	**M^3**
.11.13	**FACILITY COMMISSIONING ACTIVITIES** Phase 4 • Activities associated with startup and testing or commissioning of the facility, systems, and equipment. Examples of activities included in this element are: testing using cold or simulated waste; testing using hot or actual waste; training O&M workers; establishing and refining operational parameters, safety, and accident procedures and protocol; performing optimization studies; selecting, establishing, and defining management and working teams. Testing and start up are considered complete when technology operations can be sustained at specified operational and quality standards.	**LS**
.11.9x	**OTHER** Phase 4 to 5 • Other cost associated with construction and operations and maintenance of treatment plant, facility, equipment, or processes.	**M^3**
.12	**STORAGE FACILITY/PROCESS**	
.12.01	**RESERVED FOR FUTURE USE**	
.12.02	**CONVENTIONAL STORAGE/WAREHOUSES** Phase 4 • This element provides for constructing permanent facilities including sheds, warehouses, and other facilities not included in the environmental management facility but that are required for storage of hazardous waste and materials. Low/moderate hazardous waste streams are those waste streams exclusively regulated under 40 CFR Part 261 and that require minimal health and safety personnel protection (PPE Level C or lower). Phase 5 • This element provides for the operation and maintenance of the facilities (e.g., receiving, loading, and unloading) for as long as they are required. Phase 6 • This element provides for long-term surveillance, monitoring, and maintenance of the facility, to ensure compliance with requirements after operations cease.	**M^2** **M^3/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.12.03	**STORAGE FACILITY FRONT-END—LOW/MODERATE HAZARD** Phase 4 • This element provides for constructing permanent facilities for receiving and inspection, container handling, open/dump/sort, and preparation of low/moderate hazardous waste streams for storage. Low/moderate hazardous waste streams are those waste streams exclusively regulated under 40 CFR Part 261 and that require minimal health and safety personnel protection (PPE Level C or lower). Phase 5 • This element provides for the operation and maintenance of the facilities for receiving and inspection, container handling, open/dump/sort, and preparation of low/moderate hazardous waste streams for waste storage. It also includes maintenance of these facilities during the waste storage period. Phase 6 • This element provides for long-term surveillance, monitoring, and maintenance of the facility to ensure compliance with requirements after operations cease.	**M^2** **M^3/YR** **M^2/YR**
.12.04	**STORAGE FACILITY FRONT-END—HIGH/REMOTE HAZARD** Phase 4 • This element provides for constructing permanent facilities for receiving and inspection, container handling, open/dump/sort, and preparation of high hazardous and remote-handled waste streams for storage. Phase 5 • This element provides for the operation and maintenance of the facilities for receiving and inspection, container handling, open/dump/sort, and preparation of high hazardous and remote-handled waste streams for waste storage. It also includes maintenance of these facilities during the waste-storage period. Phase 6 • This element provides for long-term surveillance, monitoring, and maintenance of the facility to ensure compliance with requirements after operations cease.	**M^2** **M^3/YR** **M^2/YR**
.12.05	**CONTACT HANDLED STORAGE** Phase 4 • This element provides for constructing permanent storage facilities for contact-handled hazardous waste streams (e.g., high hazardous wastes including hazardous/toxic waste and radioactive waste). Phase 5 • This element provides for the processing of contact-handled waste streams and operation of permanent storage facilities for contact-handled hazardous waste streams (e.g., high hazardous wastes including hazardous/toxic waste and radioactive waste). The operations include receiving, loading, unloading and maintenance of these facilities for as long as they are required. Phase 6 • This element provides for long-term surveillance, monitoring, and maintenance of the facility to ensure compliance with requirements after operations cease.	**M^2** **M^3/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.12.06	**REMOTE HANDLED STORAGE** Phase 4 • This element includes constructing permanent storage facilities for remote-handled hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and alpha contaminated waste requiring remote handling). Phase 5 • This element includes processing remote-handled hazardous waste streams (e.g., high-level hazardous wastes including high-level radioactive waste and alpha-contaminated waste requiring remote handling) and operations of permanent storage facilities for those waste streams (Operations includes receiving, loading, and unloading waste materials and maintaining the storage facility as long as necessary. Phase 6 • This element includes long-term surveillance and maintenance through facility closure or D&D.	**M^2** **M^3/YR** **M^2/YR**
.12.07	**MIXED WASTE STORAGE** Phase 4 • This element includes constructing permanent storage facilities for mixed waste streams. Mixed waste is waste with both hazardous and radiological constituents. Phase 5 • This element includes processing the mixed waste stream (i.e., waste with both hazardous and radiological constituents and operations of the permanent mixed waste storage. Operations include receiving, loading, and unloading mixed waste and maintaining the facilities for as long as necessary. Phase 6 • This element includes long-term surveillance and maintenance through facility closure or D&D.	**M^2** **M^3/YR** **M^2/YR**
.12.08	**FACILITIES AND SHEDS FOR TEMPORARY STORAGE** Phase 4 • This element includes constructing and installing facilities for short-term or temporary storage of low/moderate hazardous waste. Note: Temporary facilities for all other purposes are included in element X.05.01 Site Work—Mobilization. Phase 5 • This element includes the operation and maintenance of temporary facilities. Operations includes receiving, loading, and unloading low/moderate hazardous waste and maintaining facilities for as long as necessary.	**M^2** **M^2/YR**
.12.09	**WASTE STORAGE FEES AND TAXES** Phases 4 to 6 • Cost of fees and taxes charged by one Government agency to another or by one organization to another for the storage of HTR waste. For some environmental restoration programs, refer to element X.32.xx for disposal options.	**M^3**

ECES #	ECES DESCRIPTION	UOM
.12.9x	**OTHER** Phases 4 • Constructing other storage facilities or processes or the costs of other activities associated with storage facilities or processes. Phase 5 • Operations and maintenance of other storage facilities or processes or the costs of O&M of other activities associated with storage facilities or processes. Phase 6 • Long-term surveillance and maintenance of other storage facilities or processes or the costs of long-term surveillance and maintenance other activities associated with storage facilities or processes.	**M^3** **M^3/YR** **M^3**
.13	**DISPOSAL FACILITY/PROCESS**	
.13.01	**RESERVED FOR FUTURE USE**	
.13.02	**DISPOSAL FACILITY FRONT-END—LOW/MODERATE HAZARD** Phase 4 • This element includes constructing permanent facilities for receiving and inspecting, container handling, open/dump/sort, and preparing low/moderate hazardous waste streams for disposal. Low/moderate hazardous waste streams are those waste streams exclusively regulated under 40 CFR Part 261 and that require minimal health and safety personnel protection (PPE Level C or lower). Phase 5 • This element includes the operations and maintenance of the facilities including receiving and inspecting, container handling, open/dump/sort, and preparing low/moderate hazardous waste streams for disposal. This element also includes operation and maintenance of the facilities during the waste-disposal period. Phase 6 • This element provides for the long-term surveillance and maintenance for an indefinite period after facility closure.	**M^2** **M^3/YR** **M^2YR**
.13.03	**DISPOSAL FACILITY FRONT-END—HIGH/REMOTE HAZARD** Phase 4 • This element includes constructing permanent facilities for receiving and inspecting, container handling, open/dump/sort, and preparing highly hazardous, radioactive, explosive, and remote-handled waste streams for disposal. Highly hazardous or remote-handled wastes are those waste streams that are not exclusively regulated under 40 CFR Part 261 or that require high levels of personnel protection (PPE Level B or higher), engineering controls, and personnel exposure monitoring. Phase 5 • This element includes operating and maintaining facilities for receiving and inspecting, container handling, open/dump/sort, and preparing highly hazardous, radioactive, explosive and remote-handled waste streams for disposal. It also includes operating and maintaining the facilities during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^2** **M^3/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.13.04	**LANDFILL** Phase 4 • This element includes constructing a landfill. See also Solids/Soils Containment (e.g., Capping/Barrier) Collection, or Control under X.19.xx. Landfills are engineered structures that have containment and leachate/runoff control features. Phase 5 • This element includes the operation and maintenance of a landfill, burial ground, burial trench, or burial pit. Operation and maintenance includes receiving, inspecting, handling, and monitoring of waste. It also includes operations and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.05	**ABOVEGROUND VAULT** Phase 4 • This element includes constructing an aboveground disposal vault. An aboveground vault is a structure composed of concrete or other building material with three walls, a floor, and a roof constructed above grade. The vault allows for entry of persons and machinery. Phase 5 • This element includes the operation and maintenance of an aboveground disposal vault including receiving, inspecting, handling, and monitoring. It also includes operation and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.06	**UNDERGROUND VAULT** Phase 4 • This element includes constructing an underground disposal vault. An underground vault is a structure composed of concrete or other building material with three walls, a floor, and a roof constructed below grade. The vault allows for entry of persons and machinery. Phase 5 • This element includes the operation and maintenance of an underground disposal vault including receiving, inspecting, handling, and monitoring. It also includes operation and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.13.07	**UNDERGROUND MINE/SHAFT** Phase 4 • This element includes constructing an underground disposal mine/shaft. A mine/shaft is an excavation with the floors, walls, and ceiling composed primarily of natural material. The ceiling, walls, and floor may have supports of wood, steel, or concrete as necessary. Phase 5 • This element includes the operation and maintenance of an underground disposal mine/shaft including receiving, inspecting, handling, and monitoring. It also includes operation and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.08	**TANKS** Phase 4 • This element includes constructing tanks for use as disposal units. Tanks are those structures that are regulated under 40 CFR Part 280, underground storage tanks or 40 CFR Part 264 Subpart J, aboveground storage tanks. Phase 5 • This element includes the operation and maintenance of the disposal storage tanks including receiving, inspecting, handling, and monitoring. It also includes operation and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **EA/YR**
.13.09	**PADS (TUMULUS/RETRIEVABLE STORAGE/OTHER)** Phase 4 • This element includes constructing disposal pads (tumulus, retrievable storage, or other). These structures have a floor of concrete or other relatively impervious material, possibly with walls, but lack a roof or ceiling. Pads may be at or below grade. Phase 5 • This element includes the operation and maintenance of the pad facility including receiving, inspecting, handling, and monitoring of disposal pads (tumulus, retrievable storage, or other). Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility.	**M^2** **M^2/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.13.10	**CONFINED DISPOSAL FACILITIES (CDFS)** Phase 4 • This element includes constructing confined disposal facilities (CDFs), which are engineered structures enclosed by dikes and designed to retain dredged material. They may be located upland (above the water table), partially in the water near shore, or completely surrounded by water. A CDF may have a large cell for material disposal and adjoining cells for retention and decantation of turbid, supernatant water. A variety of linings have been used to prevent seepage through the dike walls. The most effective are clay or bentonite-cement slurries, but sand, soil, and sediment linings have also been used. Phase 5 • This element includes the operation and maintenance of the CDF including receiving, inspecting, handling, and monitoring. It also includes operation and maintenance of the facilities during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.11	**ENGINEERED DISPOSAL** Phase 4 • This element includes constructing engineered disposal facilities not specifically addressed elsewhere in this ECES (e.g., Aboveground and Underground Vaults). These engineered disposal facilities are for disposal of radioactive (non-RCRA) low-level waste and mixed (RCRA) low-level waste. Typical construction includes the foundation, leachate collection (double leachate collection for RCRA waste), monitoring systems, concrete vaults, and earthen material covers. Phase 5 • This element includes the operation and maintenance of the engineered disposal facilities including receiving, inspecting, handling, and monitoring. Construction of the facility is often a continuous process concurrent with the placement of waste containers. This element also includes operation and maintenance of the facility during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.12	**INTERMEDIATE DEPTH DISPOSAL (BURIAL GROUNDS/TRENCHES/PITS)** Phase 4 • This element includes constructing intermediate-depth disposal facilities. These facilities are excavated below grade with no containment features (either geological or engineered). They may also include a surface cover of natural materials. Phase 5 • This element includes the operation and maintenance of the intermediate-depth facilities including receiving, inspecting, handling, and monitoring of intermediate-depth disposal facilities. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.13.13	**GEOLOGIC DISPOSAL** Phase 4 • This element includes constructing geologic disposal facilities such as the Waste Isolation Pilot Plant (WIPP). The WIPP is designed to contain transuranic waste for more than 10,000 years by taking advantage of the natural process of the encapsulation of the disposal unit buried 2,000 feet below the surface in a salt mine. Phase 5 • This element includes the operation and maintenance of the geologic disposal facility including receiving, inspecting, handling, and monitoring. In the case of WIPP this operation is an involved labor-intensive process ensuring the acceptance of waste and proper placement of it. Elements such as X.32 Material Handling/Transportation should be used in conjunction with this element. It also includes operation and maintenance of the facilities during the waste-disposal period. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.14	**SHALLOW LAND DISPOSAL** Phase 4 • This element includes constructing shallow land disposal facilities. Shallow Land Disposal facilities are a shallow (as compared to deep geologic disposal) trench system without engineered features such as those included in the Engineered Disposal Facilities. Drums or other containers are placed in the trench and covered with seven feet of soil, clay, and impervious materials similar to a RCRA Subtitle D cap included in X.19.05. Phase 5 • This element includes the operation and maintenance of shallow land disposal facilities including receiving, inspecting, handling (placement of drums/containers) and monitoring. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**M^3** **M^3/YR** **M^2/YR**
.13.15	**DEEP WELL INJECTION** Phase 4 • This element includes constructing deep well disposal facilities. Waste is injected into geologic formations under conditions defined in 40 CFR 148, which provides the parameters allowing injection of waste into geologic formations. Phase 5 • This element includes the operation and maintenance of deep well disposal facilities including receiving, inspecting, handling, and monitoring. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**EA** **EA/YR** **EA/YR**

ECES #	ECES DESCRIPTION	UOM
.13.16	**SILO DISPOSAL** Phase 4 • This element includes constructing a silo disposal system, a type of engineered disposal facility (see X.13.11) designed for disposal of 30 to 5,000 M^3 of radioactive (non-RCRA) low-level waste and mixed (RCRA) low-level waste. Silos are small, engineered, aboveground, cylindrical, reinforced concrete disposal units constructed in clusters. When a silo is filled with waste containers, it is back-filled with sand and cast in place with reinforced concrete. When all silos are filled, they are back-filled and covered with a multi-layer cap. Phase 5 • This element includes operation and maintenance of silo disposal facilities including receiving, inspecting, handling (placement of waste containers), and monitoring. It also includes maintenance of this facility during the waste-disposal operational period. Phase 6 • This element provides for the long- term surveillance and maintenance after facility closure for an indefinite period of time.	**M^3** **EA/YR** **EA/YR**
.13.17	**BORE - HOLE DISPOSAL** Phase 4 • This element includes using borehole disposal technology, which is a stand alone engineered disposal unit (see X.13.11) designed for disposal of 1 cubic meter of radioactive (non-RCRA) low-level waste and mixed (RCRA) low-level waste. Each bore-hole is drilled into a suitable shallow geologic formation, backfilled with concrete, and completed with a multi-layer engineered cap. Phase 5 • This element provides for the operation and maintenance of borehole disposal facilities including receiving, inspecting, handling (placement of waste), and monitoring. Phase 6 • This element includes long-term surveillance and maintenance for an indefinite period after facility closure.	**EA** **EA/YR** **EA/YR**
.13.18	**DISPOSAL FEES AND TAXES (FOR COMMERCIAL DISPOSAL SEE ECES X.33)** Phase 4 to 6 • This element includes costs and any other fees and tax charges levied on one Government agency or department/organization by another for waste disposal. For some environmental restoration programs, refer to element X.33.xx for disposal options.	**M^3**
.13.9x	**OTHER** Phases 4 • Construction of other disposal facilities or processes or costs of other activities associated with storage facilities or processes. Phase 5 • Operations and maintenance of other disposal facilities or processes or O&M costs of other activities associated with disposal facilities or processes. Phase 6 • Long—term surveillance and maintenance of other disposal facilities or processes or costs of long—term surveillance and maintenance for other activities associated with disposal facilities or processes. UOM=M^3	**M^3** **M^3/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.14	**ORDNANCE AND EXPLOSIVES (OE) REMOVAL AND DESTRUCTION (CWM is Included in Waste Management X.11 and Technologies X.21-X.31 and X34)** (Chemical Warfare Materials (CWM) are included in Element X.11 and Element X.21-X.31, and X.34)	
.14.01	**DEMOLITION FOR OE REMOVAL** Phase 4 • This element includes preparing an area for explosive demolition activities. Activities include the using sandbags, using heavy equipment, clearing brush, running electrical wire from a safe area to the point where explosives operations will be conducted. Building a fence, posting warning signs, or constructing a site to be used for destroying unexploded ordnance (UXO)/munitions found during OE activities. See also Demolition under Element X.05.04.	**M^2**
.14.02	**BRUSH CLEARING WITH OE** Phase 4 • This element includes forming work teams to remove brush for either surface or subsurface UXO activities. Members of the work teams will be exposed to UXO. Teams will have at least one UXO qualified person to act as a safety observer. Use of saws, axe, and other brush clearing equipment is required.	**M^2**
.14.03	**BLAST MATS** Phase 4 • This element includes using blast mats to catch rocks and other fragments. Commercial mats made of rubber and other materials are used to cover explosives.	**EA**
.14.04	**BLAST SHIELDS** Phase 4 • This element includes using blast shields. These shields are engineering controls designed to protect personnel and the public from accidental detonations of UXO. They are usually locally built from plans drawn up by the U. S. Army, Corps of Engineers, Huntsville, Alabama Civil Structures Branch. They are made of various materials (usually aluminum).	**EA**
.14.05	**SURFACE SWEEP (VISUAL)** Phase 4 • This element includes using UXO teams, up to seven people, that walk in a line formation and investigate all surface items that are potential UXO. Teams may be supplemented by non-UXO personnel who have UXO safety training.	**M^2**
.14.06	**SURFACE SWEEP (MAGNETOMETER)** Phase 4 • This element includes using UXO Teams, of up to seven people, that, with magnetometers to aid the search, walk in a line formation and investigate all surface items that are potential UXO. This activity usually occurs in forests where leaf and brush cover impedes visual sweeps. Magnetometers detect only ferrous metals. Non-UXO personnel who have UXO safety training can supplement teams.	**M^2**
.14.07	**SURFACE SWEEP (MAG & FLAG)** Phase 4 • This activity includes using magnetometers to conduct a surface sweep and flags to mark anomalies detected during the sweep. Mag and Flag on an OE project includes dividing the site into grids, normally 200'x 200'. Teams of up to seven people mark off five—foot lanes and use magnetometers to locate all subsurface anomalies in a grid. Each anomaly is marked with a pin flag for future investigation.	**M^2**

ECES #	ECES DESCRIPTION	UOM
.14.08	**EXCAVATE BY HAND 0' - 2' DEPTH** Phase 4 • This element involves manual excavation activities to a depth not to exceed two feet. Teams of up to seven people use hand tools (i.e., shovels, trowels, picks) to investigate subsurface anomalies and determine if they are UXO. Surface Sweep (Mag and Flag) and Excavation by hand can be combined if all team members are UXO qualified. The effort is very tedious and dangerous since current detection and location equipment give inaccurate depth.	**M^3**
.14.09	**EXCAVATE WITH HEAVY EQUIPMENT > 2' DEPTH** Phase 4 • This element includes excavation activities using heavy equipment in hard ground or at depths exceeding 2 feet. Heavy equipment is allowed to dig within 12 inches of an anomaly. Then hand tools are used. The object is to safely determine if the anomaly is a UXO.	**M^3**
.14.10	**SIFTING** Phase 4 • This element involves sifting activities at sites where the area is saturated with small metal and the UXO items in the investigating area are safe to disturb. UXO teams may use a hand or mechanical sifter to separate the soil and debris from the UXO. UXO personnel stand at the sifter or at a conveyor and separate the UXO from the scrap and debris. The sifter is sometimes used to separate chunks of explosives from soil. To separate smaller materials from larger materials by using a sieve. Smaller items will pass through the sieve and larger items will be retained on the sieve.	**M^3**
.14.11	**REMOVAL OF CHEMICAL WARFARE MATERIAL (CWM)** Phase 4 • This element includes the removal of CMW material. CWM is military munitions or containers filled with chemical agents (e.g., Mustard Agent, VX, GB, Lewisite). UXO Teams are tasked to investigate anomalies at suspect CWM sites and determine if CWM items are present. If CWM items are found, the items are turned over to Technical Escort EOD personnel and PMNSM for stabilization, transportation, storage and disposal.	**EA**
.14.12	**OE ON-SITE DESTRUCTION** Phase 4 • This element involves OE on-site destruction. When UXO items are found during OE investigations, the normal procedure is to destroy them in place. The second choice is to transport them to another location on that project site and destroy them.	**EA**
.14.13	**BUNKERS (TEMPORARY)** Phase 4 • This element involves the temporary storage of explosives in bunkers. The correct term for an explosive storage facility is **magazine** rather than bunker. These bunkers are ATF approved containers for temporary storage of explosives and UXO awaiting destruction.	**EA**
.14.9x	**OTHER (USE NUMBERS 90-99)** Phase 4 • Costs for other activities associate with OE removal and destruction.	**EA**
.15	**DRUMS/TANKS/STRUCTURES/MISCELLANEOUS REMOVAL/ABATEMENT**	
.15.01	**DRUM REMOVAL** Phase 4 • This element includes drum removal activities such as locating buried or submerged drums, excavating buried drums by machine or hand, handling drums, cleaning and decontaminating drums, and crushing and shredding drums as necessary. This activity excludes removing drum contents; see X.20.01 and X.20.03 for content removal.	**EA**

ECES #	ECES DESCRIPTION	UOM
.15.02	**TANK REMOVAL** Phase 4 • This element includes tank removal activities such as locating buried or submerged tanks, excavating buried tanks by machine or hand, cleaning and decontaminating tanks, and cutting, demolishing and crushing tanks. This activity excludes removing tank contents; see X.20.01 and X.20.03 for content removal.	**EA**
.15.03	**STRUCTURE REMOVAL** Phase 4 • This element includes structure removal activities, such as removal of existing structures (e.g., buildings, pump stations, and out-fall structures) after decontamination and demolition. Use X.05.04 or X.14.01 for cost of demolition, and applicable technologies (X.21.xx to X.31.xx, and X.34.xx) for cost of decontamination.	**M^2**
.15.04	**ASBESTOS ABATEMENT** Phase 4 • This element includes asbestos abatement activities such as isolating work areas, removing or encapsulating asbestos, cleaning up, packaging waste for disposal, and conducting final inspections. Also included are HEPA filtration devices, vacuums, air-monitoring equipment, and amended water.	**M^2**
.15.05	**PIPING AND PIPELINE REMOVAL** Phase 4 • This element includes piping/pipeline removal activities such as locating buried or aboveground piping; excavating buried piping by machine or hand; cutting, demolishing, and handling pipe; and removing concrete pipe pits.	**M**
.15.06	**WELL ABANDONMENT** Phase 4 • This element includes well abandonment activities such as properly sealing and abandoning wells to eliminate physical hazards of the well and contaminant migration pathway and to prevent hydraulic head changes and the mixing of water between aquifers. Boreholes must be clear of obstruction prior to abandonment, obstacles must be removed from the well, and the well must be grouted prior to pulling the casing. Sealants, used to provide a watertight barrier to contaminant migration, consist of cement-based grout, bentonite clay, or a combination of these substances. In some cases, re-drilling may be necessary to properly abandon the well. Phase 6 • This element includes performing surveillance and inspection of the abandoned well to ensure that the seals, grouts, and other measures continue to perform their intended purpose preventing contaminant migration.	**EA** **EA/YR**
.15.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Costs for performing other activities associated with drums, tanks, structures, miscellaneous removal or abatement.	**LS**

ECES #	ECES DESCRIPTION	UOM
.16	**AIR POLLUTION/GAS COLLECTION AND CONTROL**	
.16.01	**GAS/VAPOR COLLECTION TRENCH SYSTEM** Phase 4 • This element includes constructing gas/vapor collection trench systems, which are deep narrow trench backfilled with gravel, to form a path of least resistance through which gases move upward to a collection apparatus. Assemblies include excavation, backfill, geotextile liners, well point dewatering, and a ventilation system for the site. Phase 5 • This element includes operations and maintenance activities such as replacing parts and consumable materials, cleaning components, making repairs, and other performing other activities for proper and optimal operation of the gas/vapor collection trench system. Phase 6 • This element includes costs associated with long- term surveillance, maintenance, and monitoring activities needed to ensure compliance with requirements.	**M** **M/YR** **M/YR**
.16.02	**GAS/VAPOR COLLECTION WELL SYSTEM** Phase 4 • This element involves constructing gas/vapor collection wells to permit the venting of underground gases to a collection well system in order to prevent migration or buildup. Collection and monitoring activities include drilling rig set up, well drilling, handling of cuttings/water, casing, casing removal, placing gravel pack material, grouting, constructing wet well, well development/testing, well screen installation, capping. Costs for well house, well pump and instrumentation, well piping, valves and fittings and electrical systems are also included. Also included are blowers or compressors, piping, metering, and control systems. Gas treatment is not included in the costs of this element. Gas/vapor collection should not be confused with the soil vapor extraction process listed under Soil Vapor Extraction (X.25.17). Phase 5 • This element includes operations and maintenance activities such as replacing parts and consumable materials, cleaning components, making repairs, and performing other activities for proper and optimal operation of gas/vapor collection well system. Phase 6 • This element includes all costs associated with long- term surveillance, maintenance, and monitoring activities needed to ensure compliance with requirements.	**EA** **EA/YR** **EA/YR**
.16.03	**GAS/VAPOR COLLECTION AT LAGOON COVER** Phase 4 • This element includes the labor, material and equipment used to construct the subsystem for venting gases and vapors at lagoon covers to prevent migration or buildup. Assemblies include collection hose, tank, vacuum blower/compressor, valves, boxes, and manholes. Phase 5 • This element includes operations and maintenance activities such as replacing parts and consumable materials, cleaning components, making repairs, and performing other activities for proper and optimal operation of gas/vapor collection at lagoon covers. Phase 6 • This element includes all costs associated with long- term surveillance, maintenance, and monitoring activities needed to ensure compliance with requirements.	**M^2** **M^2/YR** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.16.04	**FUGITIVE DUST/VAPOR/GAS EMISSIONS CONTROL** Phase 4 • This element includes installing fugitive dust/vapor/gas emissions control systems to prevent the spread of airborne contaminants. Assemblies include sprayed chemical dust suppressants, wind fences/screens, synthetic covers over waste piles, and water spraying. See also specific gas technologies under elements X.21.xx to X.31.xx, and X.34.xx. Phase 5 • This element includes operations and maintenance activities such as replacing parts and consumable materials, cleaning components, making repairs, and performing other activities for proper and optimal operation of fugitive/vapor/gas emission control system. Phase 6 • This element includes all costs associated with long- term surveillance, maintenance, and monitoring activities needed to ensure compliance with various requirements.	**M^2** **M^2/YR** **M^2/YR**
.16.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other devices or elements associated with air pollution or gas collection and control. Phase 5 • Operations and maintenance of other devices or elements associated with air pollution or gas collection and control. Phase 6 • Long— term surveillance, maintenance, and monitoring of other devices or elements associated with air pollution or gas collection and control.	**M^2** **M^2/YR** **M^2/YR**
.17	**SURFACE WATER/SEDIMENTS CONTAINMENT, COLLECTION OR CONTROL**	
.17.01	**DREDGING/EXCAVATING** Phase 4 • This element includes dredging and excavating activities. Dredging is the removal of sediment and sludge with overlying water. Dredging may be used to remove sediments in contaminated settling basins, lagoons, and retention ponds. Dredging includes hydraulic, mechanical, and pneumatic dredges using cutterheads, bucket dredges, wheel dredges, and suction dredging. Excavating is the removal of soils, solids, or contaminated materials from the ground. Dredging/excavating during Phase 4 is for purposes of first-time construction or action. Maintenance and operation of the dredging or excavating equipment is considered part of the dredging or excavating cost. This cost will be included in the price a contractor bids. See also Excavation and Earthwork under X.05.05. Phase 5 and 6 • This element includes dredging and excavating to maintain the system for ongoing operations. For example, this includes dredging or excavating sediments or deposits in a weir, plume, or channel.	**M^3** **M^3**

ECES #	ECES DESCRIPTION	UOM
.17.02	**BERMS** Phase 4 • This element includes constructing berms, which are earthen structures to control contaminated surface water by diverting its flow. The primary purpose of berms is to divert surface runoff that has entered a contaminated area and must be collected. Activities include excavation and backfill, hauling, pumping to dry the site, and placing drainage facing materials. Phases 5 and 6 • This element includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the berm.	**M^3** **M/YR**
.17.03	**FLOODWALLS** Phase 4 • This element includes constructing floodwalls. Floodwalls are structures used to protect land from flooding and inundation. Activities include excavation and backfill, hauling, pumping to dry the site, concrete or other structures, etc. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to ensure structural stability of the berm.	**M^2** **M^2/YR**
.17.04	**LEVEES/DAMS/DIKE** Phase 4 • This activity includes constructing levees, dams and dikes used to prevent a body of contaminated water from overflowing. Activities include excavation and backfill, hauling, drainage facing materials, pumping to dry the site and other activities required for constructing the structures. Phases 5 and 6 • This element includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the levees/dams/dike.	**M^3** **M^3/YR**
.17.05	**TERRACES AND BENCHES** Phase 4 • This activity includes constructing terraces and benches for controlling contaminated surface water runoff by intercepting the flow of water before it causes erosion. Activities include site preparation, excavation and backfill, hauling, soil stabilization, pumping to dry the site, geotechnical testing, and placing drainage facing materials. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to ensure structural stability of the terraces and benches.	**M** **M/YR**

ECES #	ECES DESCRIPTION	UOM
.17.06	**CHANNELS/WATERWAYS/DITCHES** Phase 4 • This element includes constructing a pathway for moving and directing water, liquids, or other contaminated fluids. Construction activities include excavating, pumping to dry the site, pouring concrete, filling, doing form work, and laying ripraps. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to maintain the channels/waterways/ditches.	**M^3** **M/YR**
.17.07	**CHUTES OR FLUMES** Phase 4 • This element includes constructing chutes and flumes. Chutes and flumes are natural or man-made channels that divert contaminated water away from a given area. Activities include grading, building earthwork, pouring concrete, doing formwork, reinforcing steel, and laying riprap. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to maintain the chutes and flumes.	**M** **M/YR**
.17.08	**SEDIMENT BARRIERS** Phase 4 • This element includes the constructing sediment barriers to control the amount of sediments that are suspended and transported by the flow of contaminated surface water. Activities include silt fencing, installing straw bales, pumping, and excavating/grading temporary sediment basins. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing areas, making repairs, and performing other activities to maintain the sediments barriers.	**M** **M/YR**
.17.09	**STORM DRAINAGE (See X.05.28 for Storm Sewer)** Phase 4 • This element includes piping, junction boxes, manholes, inlets, invert construction, grates, covers, headwalls, riprap, excavation, and backfill for storm water drainage in contaminated areas. Phases 5 and 6 • This element includes maintenance activities such as inspecting areas, replacing materials, clearing the area, making repairs, and performing other activities to maintain the storm drains.	**M** **M/YR**

ECES #	ECES DESCRIPTION	UOM
.17.10	**LAGOONS/BASINS/TANKS** Phase 4 • This element includes constructing lagoons/basins/tanks (Also see Element X.13.08) for storing liquid wastes. Activities include the constructing earth structures, liners, spillways, intake/outlet structures, underground tanks, aboveground tanks, concrete retention basins, and overtopping alarm systems. The element also includes excavation and earthwork, ripraps, construction of pumping stations and controls, lift stations and controls, manholes, piping and fittings, hosing, and holding tanks. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to maintain the lagoons/basins/tanks.	**M^3** **M^2/YR**
.17.11	**PUMPING/DRAINING/COLLECTION** Phase 4 • This element includes work associated with pumping or draining aboveground or underground tanks and basins, and other liquids. This element also includes inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system during the removal process. Phases 5 and 6 • This element includes removing liquid and sludge as part of operations and maintenance activities. Such activities will occur as there are leaks and infiltration into structures that requires the removal of the waste. The element also includes inspecting of area, replacing materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system during the removal process.	**M^3** **M^3**
.17.12	**EROSION CONTROL** Phase 4 • This element includes establishing turf and planting of trees, shrubs, and ground covers for erosion control. Phases 5 and 6 • This element includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and performing other activities ensure proper erosion control. This element also includes mowing of established turf.	**M^2** **M^2/YR**
.17.13	**AQUATIC BARRIER** Phase 4 • This element includes constructing or installing an aquatic barrier system, an impassable barrier and/or fish guidance system within a stream channel or waterway to restrict fish from entering and/or exiting the system or to guide fish to more appropriate areas within the aquatic system. The system may be a physical structure; a mechanical, sonic, or electrical field, or a strobe-stimulated or pressure-induced system that may be permanently deployed within the stream system or activated to correspond to critical fish movements or migrations. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities that ensure proper functioning of the aquatic barrier system.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.17.14	**SEDIMENT CAPPING** Phase 4 • This element includes constructing a sediment cap to contain contaminated soil and solids. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing materials, clearing the area, making repairs, and performing other activities to ensure proper functioning of the sediment cap.	**M^2** **M^2/YR**
.17.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Constructing or installing other devices or elements associated with surface water, sediments containment, collection and control. Phases 5 and 6 • Perform maintenance activities such as area inspection, replacing materials, clearing of area, and making repairs on other surface water, sediments containment, collection and control devices or elements.	**M^2** **M^2/YR**
.18	**GROUNDWATER CONTAINMENT, COLLECTION, OR CONTROL**	
.18.01	**EXTRACTION WELLS** Phase 4 • This element includes constructing extraction wells, typically used for pumping groundwater. Extraction well construction activities include setting up the drilling, drilling the well, handling cuttings/water, casing, removing casing, installing gravel pack material, grouting, installing wet well , developing/testing the well, installing well screens, capping, constructing the well house, and installing the well pump and instrumentation, well piping, valves, fittings, electrical and other components. Phase 5 • This element includes maintenance activities such as inspecting the, replacing components, clearing the area, making repairs, and performing other activities to ensure proper functioning of injection wells. Phase 6 • This element includes costs of long- term surveillance, maintenance, and monitoring activities associated with abandoned wells to ensure there are no contaminant pathways or leakage of contaminants.	**EA** **EA/YR** **EA/YR**

ECES #	ECES DESCRIPTION	UOM
.18.02	**INJECTION WELLS** Phase 4 • This element includes constructing injection wells for injecting liquid wastes deep underground between geologically impermeable layers, usually of clay or shale, to contain or remove the contaminant plume, to direct contaminants to the extraction wells, or to lower the water table to prevent it from intercepting buried hazardous, toxic, and radioactive contaminants. Injection well installation activities include drilling rig set up, well drilling, well construction, handling of cuttings/water, casing, casing removal, gravel pack material, grout, wet well, well developing/testing, well screen, capping, well house, well pump and instrumentation, well piping, valves, fittings, electrical, and other components. Phase 5 • This element includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities ensure proper functioning of injection wells. Phase 6 • This element includes costs of long- term surveillance, maintenance, and monitoring activities associated with injection wells to ensure there are no contaminant pathways or leakage of contaminants.	**EA** **EA/YR** **EA/YR**
.18.03	**SUBSURFACE DRAINAGE/COLLECTION/FRENCH DRAINS** Phase 4 • This element includes constructing subsurface drainage collection systems. Drainage/collection items associated with constructing a site subsurface gravity drainage and collection system. Assemblies include trench excavation and shoring, geotextile fabrics, liners, manholes, pumping, piping and fittings, hosing, and holding tanks. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing components, clearing the area, making repairs, and performing other activities to ensure proper functioning of subsurface drainage and collection system.	**M** **M/YR**
.18.04	**SLURRY WALLS** Phase 4 • This element includes constructing slurry walls, trenches, typically 24-36 inches thick, excavated through pervious materials to a relatively impervious underlying stratum and backfilled with a soil/bentonite or cement/bentonite slurry mixture. Slurry walls provide a vertical barrier to reduce the horizontal permeability of soil. Slurry wall construction includes excavation, bentonite slurry makeup, and backfill/slurry displacement. The operation of batch plant equipment such as storage tanks, ponds, grout plants, circulation pumps and batch mixers are also included. Phases 5 and 6 • This element includes maintenance activities such as inspecting areas, replacing materials, making repairs, and performing other activities to ensure stability of the slurry wall.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.18.05	**GROUT CURTAIN** Phase 4 • This element includes constructing grout curtains, an impenetrable barrier placed to prevent further contaminant migration by drilling into pervious rock formations at spaced intervals and injecting cement-based grouts under pressure. Grout curtain items include drilling rig, grout materials, on-site batch plants, grout pumps, and grout injection monitors. Phases 5 and 6 • This element includes maintenance activities such as inspecting and clearing the area, replacing materials, making repairs, and performing other activities to ensure the stability of the grout curtain.	**M^2** **M^2/YR**
.18.06	**SHEET PILING** Phase 4 • This element includes installing sheet piling as an impervious barrier to contaminant migration once it is driven to an impervious underlying stratum. This element includes all materials, labor and equipment to drive sheet piling and pull/salvage, if required. Phases 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing components, clearing the area, making repairs, and performing other activities to ensure the proper functioning of the sheet piling.	**M^2** **M^2/YR**
.18.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other devices or elements associated with ground water containment, collection and control. Phases 5 and 6 • Perform maintenance activities such as inspecting the area, replacing materials, clearing the area, and making repairs on other ground water containment, collection and control devices or elements.	**M^2** **M^2/YR**
.19	**SOLIDS/SOILS CONTAINMENT (e.g. CAPPING/BARRIER) COLLECTION OR CONTROL**	
.19.01	**CONTAMINATED SOIL COLLECTION (EXCAVATION)** Phase 4 • This element includes removing soil contaminated by hazardous, toxic, or radioactive contaminants. The cost of purchasing, hauling, loading, placing, and compacting clean fill also is captured with this element. Collection equipment includes excavator, front-end loader, backhoe, gradall, clamshell, dragline, and other mechanical means. Cost of revegetation is captured under X.05 Site Work and is not included in this element. Phase 5 • This element includes inspecting contaminated soil to ensure it complies with Federal, state, and local rules and regulations.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.19.02	**WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)** Phase 4 • This element includes waste containment activities such as the procuring containers and the labor to fill them with liquid, sludges, or solid hazardous, toxic, and radioactive contaminants. Examples of containers are open-top sludge containers, closed-top sludge containers, roll-off containers, open-head drums, spill containment vessels, spill containment pallets, storage tanks, drum liners, over packs and lab packs. Phase 5 • This element includes maintenance activities such as inspecting the area, clearing the area, and performing other activities to ensure wastes are not exposed to the environment and that the integrity of containers is maintained.	**M^3** **M^3/YR**
.19.03	**UPPER VEGETATIVE (TOPSOIL) LAYER** Phase 4 • This element includes installing an upper vegetative layer at the top of a cap. This element includes soil cover or topsoil placed to support vegetation and plant life. Upper vegetative layers are usually placed to reduce erosion and to protect the bottom layers. See also X.05.02, Cleanup/Landscaping/Revegetation. Phase 5 and 6 • This element includes maintenance activities such as inspecting the area, replacing components, clearing the area, mowing, reseeding, making repairs, and performing other activities to ensure the integrity of the upper vegetative layer is maintained.	**M^2** **M^2/YR**
.19.04	**RCRA C Cap** Phase 4 • This element includes installing a RCRA Subtitle C cap for use in RCRA hazardous waste applications. These caps generally consist of a 2-foot thick upper vegetative layer, a 12-inch drainage layer of sand, and a low-permeability layer comprising a synthetic liner over 2 feet of compacted clay. Gas vent layers allow trapped gas to be collected and treated. A 12-inch thick layer of native soil or sand acts as a foundation for the cap. The compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated. As a result alternate cap designs are usually considered for arid environments. Phases 5 and 6 • This element includes maintenance activities such as inspecting the cap, replacing components, clearing the area, making repairs, and performing other activities to ensure the integrity of the cap is maintained.	**M^2** **M^2/YR**
.19.05	**RCRA D Cap** Phase 4 • This element includes installing a RCRA Subtitle D cap consisting of a 6-inch upper vegetative layer, and an 18-inch thick layer of earthen material with permeability coefficient of $1x\ 10^{-5}$ cm/sec or lower. RCRA D landfills are for non-hazardous solids. Phases 5 and 6 • This element includes maintenance activities such as inspecting the cap, replacing components, clearing the area, mowing, reseeding, making repairs, and performing other activities to ensure the integrity of the cap is maintained.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.19.06	**ASPHALT/CONCRETE LAYER** Phase 4 • This element includes constructing an asphalt or concrete barrier to provide a contact and infiltration barrier between the landfill and the aboveground environment. Phases 5 and 6 • This element includes maintenance activities such as inspecting the barrier, replacing materials, repairing caps, clearing the area, and performing other activities to ensure the integrity of the barrier.	**M^2** **M^2/YR**
.19.07	**LANDFILL CAP ENHANCEMENT** Phase 4 • This element includes making enhancements to the landfill to reduce or eliminate contaminant migration. Water harvesting and vegetative covers (X.19.03) are two types of landfill cover enhancements. Water harvesting uses runoff enhancement to manage landfill site water balance. This can be achieved with metal rain gutter placed parallel to the slope. The percentage of runoff increases when gutter coverage increases. However, too much coverage (.40%) has little effect on runoff enhancement. Phases 5 and 6 • This element includes maintenance activities such as inspecting and repairing enhancements, replacing material, clearing the area, and performing other activities to ensure the integrity of the enhancements.	**M^2** **M^2/YR**
.19.08	**ENGINEERED BARRIER** Phase 4 • This element includes constructing a single or a multilayer barrier to prevent infiltration of water into a contaminated area or a landfill. Barrier materials, placed beneath the contaminated material can consist of geomembranes, geotextiles, soil, clay, and rocks. Critical components include barrier layers and drainage layers to collect the leachate in case of a barrier leakage. Phases 5 and 6 • This element includes maintenance activities such as inspecting the barrier, replacing components, clearing the area, making repairs, and performing other activities to ensure the integrity of the barrier.	**M^2** **M^2/YR**
.19.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other devices or elements associated with solid/soils containment, collection, and control. Phases 5 and 6 • Perform maintenance such as inspection, replacement of materials, clearing of area, and making repairs on other solids/soil containment, collection and control devices or elements.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.20	**LIQUIDS WASTE/SLUDGES (e.g., UST/AST) CONTAINMENT, COLLECTION, OR COLLECTION**	
.20.01	**INDUSTRIAL VACUUMING** Phase 4 • This element includes industrial vacuuming, removing wastes contained in tanks, containers, surface impoundment, or process vessels by pumping or pneumatic conveyance. Also see X.17.11 and X.20.03. Phase 5 • This element includes removing industrial resulting from ongoing activities, leaks, or infiltration; operating the unit; repairing the unit; and replacing components.	**M^3** **M^3**
.20.02	**RADIOACTIVE SPECIFIC WASTE CONTAINMENT** Phase 4 and 5 • This element includes containing radioactive specific waste including procuring fill containers and the labor to them with low-level and high-level radioactive liquid waste. Examples of containers are Low Specific Activity (LSA) waste containers, LSA drum over packs, LSA laundry containers, strong-tight containers, Type A containers, Type B shipping containers, lead-shielded containers, reusable containers, and special use containers. • This element includes maintenance activities such as inspecting the containers, clearing the area, and performing other activities to ensure wastes are not exposed to the environment and that the integrity of the containers is maintained.	**M^3** **M^3**
.20.03	**PUMPING/DRAINING/COLLECTION** Phase 4 • This element includes pumping/drainage/collection work associated with removing liquid wastes from drums, tanks, and basins. Phase 5 • This element includes pumping/drainage/collection of liquid as part of operations and maintenance activities such as when leaks occur of liquids infiltrate. Activities such as inspecting the area, replacing components, clearing areas, making repairs, and performing other activities to maintain the pumps, drains and collection system are also included.	**M^3** **M^3**
.20.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other devices or elements associated with liquid waste/sludge collection and containment. Phases 5 and 6 • Perform maintenance activities such as inspecting the devices or elements, replacing components, clearing the area, and making repairs on other liquid waste/sludge collection and containment devices or elements.	**M^3** **M^3**

ECES #	ECES DESCRIPTION	UOM
.21	**IN SITU BIOLOGICAL TREATMENT**	
.21.01	**BIOLOGICAL BARRIER** Phase 4 • This element includes installing a biological barrier across the flow path of a contaminant plume, allowing the water portion of the plume to move through the barrier and contaminants to be captured on sorbent material. The sorbent barrier consists of materials that retard the movement of organic materials and microbes that biodegrade the sorbed organic while prohibiting the movement of biologically degradable contaminants. The barrier volume provides localized control of in situ environment, such as nutrients, co-substrates, or electron donors or acceptors, to optimize biodegradation. Phase 5 • This element includes maintenance activities such as inspecting the barrier, replacing nutrients or chemical, clearing the area, and performing other activities to maintain the biological barrier system.	**M^2** **M^2/YR**
.21.02	**RESERVED FOR FUTURE USE**	
.21.03	**BIOVENTING** Phase 4 • This element includes aerating subsurface soils, using injected air as the oxygen source, to stimulate in situ biological activity and promote biodegredation of compounds amenable to biodegredation under aerobic conditions. In contrast to soil vapor extraction, bioventing is designed to maximize in-site biodegredation, rather then volatilization of amenable compounds. Thus, bioventing systems usually operate at much lower per-well airflow rates than soil vapor extraction systems. This element includes the cost of drilling wells and the equipment required for bioventing including well casing, manifold piping, and blower(s). These activities can also use Extraction Wells (X.18.01) and Injection Wells (X.18.02.) for drilling and well development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting the bioventing system, replacing materials and parts, clearing the area, making repairs, and performing other activities to maintain the pumps and system.	**M^3** **M^3/YR**
.21.04	**COMETABOLIC TREATMENT** Phase 4 • This element includes using cometabolic treatment, an emerging application involving the injection of water containing dissolved primary substrate (e.g., methane, toluene) and oxygen into groundwater to support the cometabolic breakdown of targeted organic contaminants. Co-metabolism is one form of secondary substrate transformation in which enzymes produced for primary substrate oxidation are capable of fortuitously degrading the secondary substrate even though the secondary substrates do not afford sufficient energy to sustain the microbial population. The addition of methane or methanol supports methanotrophic activity, which has been demonstrated effective to degrade chlorinated solvents, such as vinyl chloride and TCE, by cometabolism. Although toluene, propane and butane are used to stimulate a different class of microorganisms, not methanotrophs, they have been used successfully for supporting cometabolism of TCE. This element does not include drilling cost or well-development costs. If necessary, use Extraction Wells (X.18.01) and Injection Wells (X.18.02.) for drilling and well development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, replacing nutrients, replacing components, clearing the area, making repairs, and performing other activities to maintain the system.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.21.05	**CONSTRUCTED WET LANDS** Phase 4 • This element includes using natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can be a filtration or degradation. Although this technology incorporates principal components of wetland ecosystems, including organic soils, microbial fauna, algae, and vascular plants, microbial activity is responsible for most of the remediation. This element includes excavating to construct the wetland, planting wetland flora, incorporating organic soil and microbial fauna, and performing other activities essential for wetland construction. Phase 5 • This element includes inspection and maintenance of the site.	**M^2** **M^2/YR**
.21.06	**ENHANCED BIOREMEDIATION** Phase 4 • This element includes using indigenous or inoculated microorganisms (i.e., fungi, bacteria, and other microbes) to degrade (metabolize) organic contaminants found in soil and/or groundwater. Enhanced bioremediation accelerates the rate of bioremediation by increasing the concentrations of electron acceptors, nutrients, or limiting inorganic in groundwater, surface water, leachate, soil, and other media. If necessary, use Extraction Wells (X.18.01) and Injection Wells (X.18.02.) for drilling and well-development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, replacing nutrients and chemicals, clearing the area, making repairs, and performing other activities to maintain the pumps to enhance bioremediation.	**M^3** **M^3/YR**
.21.07	**LAND TREATMENT** Phase 4 • This element includes the systematic treatment of land involving the dynamic interaction of waste, soil, and biological activity to degrade, transform, and immobilize waste constituents. Land treatment is a bioremediation technology in which contaminated soils, sediments, or sludge are turned over (i.e., tilled) to aerate, and allowed to interact with the soil and climate at the site. Tilling also allows for mixing of nutrients, waste, and microorganisms, which enhance the biological activity. Phase 5 • This element includes the inspection and maintenance of the area under land treatment.	**M^2** **M^2/YR**
.21.08	**NATURAL ATTENUATION** Phases 4 and 6 • This element includes using natural processes such as dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions with soil materials, that allow for reduction of contaminant concentrations to acceptable levels. Consideration of this option requires modeling and evaluation of contaminant degradation rates and pathways. The primary objective of site modeling is to demonstrate that natural processes of contaminant degradation will reduce contaminant concentrations below regulatory standards before potential exposure pathways are completed. In addition, Sampling and sample analysis must be conducted throughout the process to confirm that degradation is proceeding at rates consistent with meeting cleanup objectives. Note: Natural attenuation is not the same as "no action." In all cases, extensive site characterization is required. Use X.07, X.08, and X.09 for characterization and sampling efforts.	**M^2**

ECES #	ECES DESCRIPTION	UOM
.21.09	**PHYTOREMEDIAITON** Phase 4 • This element includes using phytoremediation, a process that uses plants to remove, transfer, stabilize, and destroy organic/inorganic contamination in soil, sediments, groundwater, surface water, and leachate. There are several ways plants can be used for the phytoremediation. These mechanisms include enhanced rhizosphere biodegradation, hydraulic control, phyto-degradation and phyto-volatilization. This element includes the cost of purchasing plants, planting, adding nutrients or chemicals, and other essential costs. Phase 5 • This element includes inspecting and maintaining the site and providing moisture and food to plants.	**M^2** **M^2/YR**
.21.10	**BAROBALL** Phase 4 • This element includes installing a Baroball to enhance barometric pumping to remove volatile organic compounds from the soil by taking advantage of changes in barometric pressure above and below ground. When the subsurface pressure is higher, contaminants naturally move upward where they can be treated/released. The Baroball significantly increases the effectiveness of barometric pumping by preventing the inflow of air into a venting well when atmospheric pressures reverse, a condition that can reduce contaminant removal by diluting and disbursing the pollutant. Its design consists of a simple plastic sphere that seals the well from incoming surface air. Baroballs utilize a CPT truck for well installation. Phase 5 • This element includes inspecting the Baroball system and maintaining the system to ensure proper operation.	**EA** **EA/YR**
.21.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other in situ biological treatment systems. Phases 5 and 6 • Perform O&M activities such as inspecting the system, replacing materials, clearing the area, and making repairs on other in situ biological treatment.	**M^3** **M^3/YR**
.22	**EX SITU BIOLOGICAL TREATMENT**	
.22.01	**ACTIVATED SLUDGE** Phase 4 • This element includes using activated sludges—sludges that contain living organisms that are agitated and aerated to promote biological growth—to treat wastewater containing biodegradable organic compounds. Note: All activated sludge systems are not sequencing batch reactors. Sequencing batch reactors are one of about a dozen variations of activated sludge treatment and do not necessarily have to be aerated. Activated sludge assemblies include reactors, aerators, aerobic bacteria (maintained in suspension), settling tanks, and recycling lines for the settled biomass. Costs do not include pumping contaminated water to the treatment plant. Phase 5 • This element includes operations and maintenance activities such as inspecting activated sludge reactors, replacing components, cleaning areas making repairs, and performing other activities to maintain the reactor.	**M^3** **M^3/YR**
.22.02	**RESERVED FOR FUTURE USE**	

ECES #	ECES DESCRIPTION	UOM
.22.03	**BIOPILES (BIOHEAPS, BIOMOUND)** Phase 4 • This element involves using biopile processes. Biopile treatment/composting is a controlled biological process for converting contaminants to low toxicity byproducts. In most cases, indigenous microorganisms achieve degradation. The composting system is designed to provide optimum temperature, moisture, content, aeration, and nutrient conditions to promote rapid biodegradation. The compost system is typically operated so that material temperature rises to 40ºC-55ºC (105ºF-130ºF.) due to heat released by biodegradation. Bulking agents may be required. If the soil porosity is low or recalcitrant contaminants are being treated. Composting can be performed using windrows, aerated static piles (biopiles), or specially designed machines. This element includes aerator or mixers, conveyer or transport equipment, chemicals, leachate collection and control, reactor, and other items needed to use biopile treatment/composting to convert contaminants to low-toxicity byproducts. If housing is necessary, use X.11.xx. Phase 5 • This element includes operations and maintenance activities such as inspecting the biopile, replacing materials or nutrients, clearing the area, and performing other activities to maintain the biopile.	**M^3** **M^3/YR**
.22.04	**COMETABOLIC TREATMENT** Phase 4 • This element includes using cometabolism, a form of secondary substrate transformation in which enzymes produced for primary substrate oxidation are capable of fortuitously degrading the secondary substrate even though the secondary substrates do not afford sufficient energy to sustain the microbial population. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, replacing nutrients, clearing the area, and performing other activities to enhance cometabolic treatment.	**M^3** **M^3/YR**
.22.05	**GENETICALLY ENGINEERED ORGANISM** Phase 4 • This element includes treating contaminants with microorganisms that have undergone external processes by which its basic set of genes has been altered. The utilization of genetically engineered organisms involves the controlled use of these specially cultivated organisms to treat contaminants. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment facility, replacing organisms, clearing the area, and performing other activities to enhance microbiological activities.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.22.06	**LAND FARMING** Phase 4 • This element includes land farming, an ex situ soil treatment technology that uses agricultural practices to promote biodegradation of organic contaminants. Waste containing low concentrations of organic contaminants is spread over a large area and allowed to interact with the soil and climate at the site. The waste, soil, climate, and biological agents interact dynamically as a system to degrade, transform, and immobilize waste constituents. Phase 5 • This element includes operations and maintenance activities such as inspecting land farms, clearing areas, making repairs, and performing other activities to maintain the land farm.	**M^3** **M^3/YR**
.22.07	**ROTATING BIOLOGICAL CONTACTORS** Phase 4 • This element includes using rotating biological contractors (RBCs), slowly rotating circular disks covered with microorganisms and made of polystyrene, polyvinyl chloride, or other stable material, that are partly exposed to the air and partly submerged in troughs containing wastewater to degrade dissolved organic compounds. Phase 5 • This element includes operations and maintenance activities such as inspecting the RBC, replacing parts, clearing the area, making repairs, and performing other activities to maintain the RBC.	**M^3** **M^3/YR**
.22.08	**SLURRY PHASE BIOLOGICAL TREATMENT** Phase 4 • This element includes using slurry phase biological treatment, also known as Slurry Biodegradation. This treatment involves the use of microbial action to break down sludge or soils in a water suspension into simple, stable compounds. Slurry biodegradation activities include excavation, material segregation, scrubbing, aeration, bioreactor mixing, dewatering, and placement of additional nutrients. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, replacing nutrients and components, clearing the area, and performing other activities to maintain and enhance biodegradation.	**M^3** **M^3/YR**
.22.09	**TRICKLING FILTERS** Phase 4 • This element includes using a trickling filtration system, which uses a rotary sprinkler to evenly distribute a waste liquid across a bed of filtration media into which microorganisms are attached. As the waste stream trickles through the filter media, the organic contaminants are biodegraded. Trickling filters consist of a highly permeable bed of media, rotary sprinklers, porous underdrain systems, and settling tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the trickling filter system, cleaning filters, clearing the area, making repairs, and performing other activities to maintain the filters.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.22.10	**BIOLOGICAL LAGOONS** Phase 4 • This element includes using biological lagoons as facultative lagoons to treat low- to medium-strength organic wastes. Biological lagoons use a lined earthen basin and sometimes aerated to promote optimal growth of microorganisms for effective treatment of contaminated liquids and sludge. This method of treatment relies on rate of algae photosynthesis, adequacy of mixing, good inlet-outlet design and adequate air temperatures to operate efficiently. Anaerobic lagoons or aerated lagoons are modified processes that treat wastes at higher rates. Phase 5 • This element includes operations and maintenance activities such as inspecting the biological lagoon, clearing the area, making repairs, and performing other activities to maintain the biological lagoons.	**M^3** **M^3/YR**
.22.11	**ANAEROBIC SLUDGE DIGESTION** Phase 4 • This element includes using an anaerobic sludge digestion treatment process, which stabilizes sludge, by using microorganisms in the absence of oxygen. This element includes reactor, piping, instrumentation and controls, pumps, and other items necessary for anaerobic sludge digestion. Phase 5 • This element includes operation and maintenance activities such as inspecting the digester, replacing consumables, replacing parts, making repairs, cleaning areas, operating technology, and performing other activities to maintain the digester.	**M^3** **M^3/YR**
.22.12	**COMPOSTING** Phase 4 • This element includes using composting to biologically degrade soil contaminants, sludge, or municipal solid organic wastes. The contaminated media is mixed with organic nutrients. A bulking agent, such as wood chip, and inorganic nutrients are also mixed in. The mixture is then placed in (compost) piles to promote heat generation and, thus, faster and more efficient biodegradation. Composting systems can be simple windrows mixed, turned periodically, or have complete mechanical mixing and aerating systems. Phase 5 • This element includes operations and maintenance activities such as inspecting the composting system, clearing the area, making repairs, and performing other activities to maintain the composting system.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.22.13	**FUNGAL BIODEGREDATION (WHITE ROT FUNGUS)** Phase 4 • This element includes using White Rot Fungus, also known as Phanerochaete chrysosporium in a bioreactor, to degrade organopollutants. White Rot Fungus, containing lignin-degrading or wood-rotting enzymes, has the ability to degrade and mineralize a number of organopollutants including the predominant conventional explosives TNT, RDX, and HMX. In addition, White Rot Fungus has the potential to degrade and mineralize other recalcitrant materials, such as DDT, PAH, PCB, and PCP. Two different treatment configurations have been tested for White Rot Fungus, in situ and bioreactor. An aerobic system using moisturized air on wood chips is used in a reactor for biodegradation. Although White Rot Fungus degradation of TNT has been reported in laboratory-scale settings using pure cultures, several factors increase the difficulty of using this technology for full-scale treatment. These factors include competition from native bacterial populations, toxicity inhibition, chemical sorption, and the inability to meet risk-based cleanup levels. White rot works best in nitrogen-limited environments. High TNT or PCP concentrations in soil also can inhibit growth of white rot fungus. White Rot Fungus is not native to soil. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, clearing the area, making repairs, and performing other activities to maintain the fungal biodegradation system.	**M^3** **M^3/YR**
.22.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other ex situ biological treatment. Phases 5 and 6 • Perform O&M activities such as inspecting the treatment system, replacing materials, clearing the area, and making repairs on other ex situ biological treatment.	**M^3** **M^3/YR**
.23	**IN SITU CHEMICAL TREATMENT**	
.23.01	**RESERVED FOR FUTURE USE**	
.23.02	**OXYGEN RELEASE COMPOUNDS** Phase 4 • This element includes using oxygen release compounds to treat VOCs, SVOCs, and fuels. Compounds such as hydrogen peroxide or liquid or gaseous oxygen may be passively introduced in wells, trenches, or pumped into the contaminated area to enhance biotreatment. Phase 5 • This element includes operations and maintenance activities such as inspecting the area, regularly introducing materials, and performing other activities to maintain the oxygen release system.	**M^3** **M^3/YR**
.23.03	**NEUTRALIZATION** Phase 4 • This element includes using acids and caustics to adjust the pH of a wastewater stream. Costs of neutralization include acids, caustics, chemical storage, mixing basins, pH probes and controls. Acids or chemicals can also be directly applied to soil or spill sites. Phase 5 • This element includes operations and maintenance activities such as inspecting the site, preparing and feeding chemicals into the waste stream, clearing the area, making repairs, and performing other activities to maintain the neutralization system.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.23.04	**OXIDATION/REDUCTION** Phase 4 • This element includes using in situ oxidation/reduction treatments of hydrocarbon, halocarbon, radionuclides, and metal ions that contaminate groundwater and the unsaturated zone. Application of oxidants such as ozone, hydrogen peroxide, or potassium permanganate directly to the contaminant change them to more benign chemicals such as carbon dioxide and water or precipitate metal ions to a more insoluble/immobile form. Oxidants can be combined with in situ reduction, such as the use of zero valence iron. Oxidation/reduction equipment includes air compressors, oxygen generators, ozone generators, mixing tanks, injection wells, and piping. Phase 5 • This element includes operations and maintenance activities such as inspecting the site, preparing and feeding chemicals into the contaminated site, clearing the area, making repairs, and performing other activities to maintain the oxidation/reduction system.	**M^3** **M^3/YR**
.23.05	**SOIL FLUSHING (SURFACTANT/SOLVENT)** Phase 4 • This element includes using in situ soil flushing to extract contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer and, when possible, recycled. Use Extraction Wells (X.18.01) and Injection Wells (X.18.02.) for drilling and well development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting the site, preparing chemicals, clearing the area, repairing components, and performing other activities to maintain the soil flushing system.	**M^3** **M^3/YR**
.23.9x	**OTHER** Phase 4 • Construct or install other in situ chemical treatment. Phase 5 • Perform operations and maintenance activities such as inspection, replacement of materials, clearing of area, and making repairs on other in situ chemical treatment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24	**EX SITU CHEMICAL TREATMENT**	
.24.01	**GLYCOLATE/ALKALI METAL/POLYETHYLENE GLYCOL (A/PEG)** Phase 4 • This element includes using A/PEG and potassium polyethylene glycol to detoxify halogenated aromatic and other organic compounds, such as PCBs and pentachlorophenols by heating them with polyethylene glycol (PEG) and sodium hydroxide (NaPEG) or potassium hydroxide for several hours at 150°C (300°F). The APEG process decomposes PCBs and representative halogens in an exothermic and self-sustaining manner. A dechlorination reagent is formed by reacting alkali metals (such as sodium) with the polyethylene glycol in the presence of heat and oxygen. The reaction mechanism involves nucleophilic substitution/elimination and the oxidative degradation of chlorine through the generation of numerous free radicals. The process reactivity can be "tuned" or directed at various aliphatic or aromatic systems by varying the molecular weight of the polyethylene glycol. Typical by-products of the reaction are salts, such as sodium chloride, hydrogen, and hydroxylated organic derivatives. The primary advantage of the system is that the reagent is not based on a dispersed metallic sodium reaction, can tolerate low levels of water content, and is stable in air. Therefore, the process may be applicable to soils and sediments dredging and to low-moisture sludge Phase 5 • This element includes operations and maintenance activities such as inspecting and clearing the area, preparing chemicals, and repairing components.	**M^3** **M^3/YR**
.24.02	**BASE CATALYZED DECOMPOSITION PROCESS** Phase 4 • This element includes using a base-catalyzed decomposition process to remediate soils and sediments contaminated with chlorinated organic compounds, especially PCBs, dioxins, and furans. Contaminated soil is screened, processed with a crusher and pug mill. The soil is then mixed with sodium bicarbonate and heated at about 350°C for one hour, which dehalogenates 25%-75% of the halogenated aromatics. The remainder is volatilized and passed on to the second reactor, a slurry or liquid phase reactor that uses a high boiling-point hydrocarbon oil, catalyst, sodium hydroxide, and heat (350°C) to dehalogenate or decompose the contaminants. Contaminated oily liquids (such as pesticides and PCB transformer oil) are treated in the slurry/liquid phase reactor only. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.03	**CHEMICAL HYDROLYSIS** Phase 4 • This element includes using hydrolysis, the chemical reaction of water with another substance where hydrogen and hydroxyl are added to the other substance usually forming two or more new compounds. Assemblies include feed systems, storage tanks, piping, and diaphragm metering pumps. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24.04	**CHLORINATION** Phase 4 • This element includes applying chlorine to drinking water, sewage, or industrial wastes to disinfect or to oxidize undesirable compounds. Assemblies include feed systems, storage tanks, chemicals, piping, and diaphragm metering pumps. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemical feed, and repairing components.	**M^3** **M^3/YR**
.24.05	**DEHALOGENATION** Phase 4 • This element includes using a dehalogenation treatment, a chemical process in which halogenated (usually chlorinated) organic compounds in an aqueous or soil medium are mixed and heated with basic reagent to remove the halogens (usually chlorine). This element includes all dehalogenation processes that are not based on alkali metals or based catalyzed decomposition process. See Glycolate Alkali Metal/Polyethylene Glycol (X.24.01) and Base-Catalyzed Decomposition Process (X.24.02.). Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.06	**HYDROGEN REDUCTION** Phase 4 • This element includes reducing chemicals using hydrogen as reducing agent. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, purchasing and preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.07	**ION EXCHANGE** Phase 4 • This element includes using the ion exchange process to remove inorganic compounds by capturing ions on a resinous material known as ion exchange resins. Wastewater is continuously passed through a column containing the ion exchange resin until the resin becomes exhausted, at which point the resin is regenerated. Ion exchange is not a destructive technology; therefore the contaminated regenerants will need disposal. Exchangers include cation exchangers, anion exchangers, and mixed-bed exchangers. Assemblies include ion exchange columns, chemical feed pumps, and storage tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning resins, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24.08	**CHEMICAL OXIDATION/REDUCTION** Phase 4 • This element includes using oxidation/reduction (redox) reactions, in which an atom or group of atoms lose or gain electrons, to transfer electrons. In oxidation/reduction reactions the contaminants become more stable or more mobile. The addition of oxygen breaks down organic waste or chemicals such as cyanides, phenols and organic sulfur compounds. Peroxide and ozone are the oxidizing agents usually used in conjunction with UV. Heavy metals are usually reduced to less mobile forms of chemicals. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.09	**OXYGEN RELEASE COMPOUNDS** Phase 4 • This element includes using compounds such as hydrogen peroxide or liquid or gaseous oxygen to enhance biotreatment, through passive introduction into wells and trenches, or pumping into the contaminated area. Oxygen release compounds are primarily designed to treat VOCs, SVOCs, and fuels. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.10	**OZONATION** Phase 4 • This element includes using ozone as an oxidizing agent in a water or wastewater treatment process. Ozone is produced with corona discharge technology and must be produced on-site due to the hazards of transporting and storing ozone. Ozone-induced oxidation can be conducted in a batch or continuous process. Batch production uses a single reaction tank; continuous operation uses two tanks, one of which serves as an overflow tank for excess ozone. Assemblies include equipment to remove any residual ozone and monitoring units. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components. Note that the high amounts of electricity required is an operations cost.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24.11	**SOLVENT EXTRACTION** Phase 4 • This element includes using separation processes in which two immiscible or partially soluble liquid phases are brought into contact for the transfer of one or more compounds. This process is commonly referred to as liquid-liquid extraction or, more loosely, as solvent extraction. This is the separation of constituents from a liquid solution by contact with another, immiscible liquid in which the constituents are more soluble. Liquid-liquid extraction is applicable for removal of organic components from aqueous solutions into immiscible solvents. The processes are primarily physical as the solutes being transferred are ordinarily recovered without chemical change. On the other hand, the physical equilibrium relationships on which such operations are based depend mainly on the chemical characteristics of the solutes and solvents. Thus, use of a solvent that chemically resembles one component of a mixture more than the other components will lead to concentration of that component in the solvent phase, with the exclusion from the phase of the dissimilar components. The contaminant is not altered by extraction but is transferred to a different phase. The most common systems include 1) mixer-settler, consisting of a mixing chamber and a settling chamber for phase dispersion and separation; 2) extraction columns, consisting of either packed extractors or sieve-tray extractors for mixing of the solute and solvent; and 3) centrifugal contactors, which rely on centrifugal force to mix the solute and solvent. Refer to Soil Washing (X.26.35) for ex situ extraction of contaminants from soils or Soil Flushing (.X.25.11) for in situ extraction of contaminants from soils. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.12	**NEUTRALIZATION** Phase 4 This element includes neutralization, the use of acids and caustics to adjust the pH of wastewater or waste streams. Neutralization costs include initial acids or caustics, chemical storage, mixing basins, pH probes, and controls. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing, cleaning the area, and repairing components.	**M^3** **M^3/YR**
24.13	**ULTRAVIOLET (UV) PHOTOLYSIS** Phase 4 • This element includes using ultraviolet photolysis, the process by which chemical bonds are broken by ultraviolet light. Products of photo-degradation vary according to the matrix in which the process occurs, but the complete conversion of an organic contaminant, to CO_2 or H_2O for example, is not probable. Equipment for ultraviolet photolysis includes UV lamps, process pumps, and monitors. Note that this element does not include UV oxidation. See Ultraviolet Oxidation (X.24.14). Phase 5 • This element includes operations and maintenance activities such as inspecting the facility preparing chemicals, replacing parts, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24.14	**ULTRAVIOLET (UV) OXIDATION** Phase 4 • This element involves using UV oxidation, which uses UV radiation plus an oxidizing agent such as ozone or hydrogen peroxide to destroy organic and explosive components in low turbidity water and wastewater. If complete mineralization is achieved, the final products of oxidation are carbon dioxide, water, and salts. Equipment for UV oxidation includes UV lamps, storage for oxidants, piping, process pumps, and instrumentation and monitors. If ozone is used, equipment for off-gas treatment will be required. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, replacing parts, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.15	**COAGULATION/FLOCCULATION/PRECIPITATION** Phase 4 • This element includes using coagulation to increase clumping of particles in wastewater by biological or chemical means allowing for the separation of the particles from the water by sedimentation or filtration. Chemicals such as lime, alum, and iron salts often induce precipitation. Cost elements include the reactors or mixing tanks, mixing devices, water or storage tanks, pumping equipment, piping, and other instrumentation and controls. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.24.16	**ACTIVATED ALUMINA (ADSORPTION/ABSORPTION)** Phase 4 • This element includes using activated alumina as an adsorptive. Activated alumina removes a variety of contaminants, including excessive fluoride, arsenic, and selenium from contaminated liquids. The medium requires periodic cleaning with an appropriate regenerant such as alum, acid, or bases to remain effective. Assemblies include ion exchange columns, chemical feed pumps, and storage tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the sorbent materials, and repairing components.	**M^3** **M^3/YR**
.24.17	**FORAGE® SPONGE (ADSORPTION/ABSORPTION)** Phase 4 • This element includes using open-celled cellulose Forage® sponges incorporating an amine-containing chelating polymer that selectively absorbs dissolved heavy metals. The polymer is intimately bonded to the cellulose, minimizing physical separation from the supporting matrix. The functional groups in the polymer (i.e., amine and carboxyl groups) provide selective affinity for heavy metals in both cationic and anionic states, preferentially forming complexes with transition-group heavy metals. Assemblies include ion exchange columns, chemical feed pumps, and storage tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning or backwashing adsorptive materials, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.24.18	**CHEMICAL EXTRACTION (SOLVENT/ACID/ALKALINE EXTRACTION)** Phase 4 • This element includes chemical extraction using aqueous chemicals to separate contaminants from soil and solids. Contaminated soil and solids are mixed in a mixing tank or a reactor, and the contaminants are separated from the solids and released into the liquid. The solids are then separated from the extracted solution and further treatment is applied if necessary. Chemical extractants include a variety of acidic and basic solutions. Assemblies include mixing tanks or reactors, mixers, chemical feed pumps, and storage tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning or backwashing adsorptive materials, and repairing components.	**M^3** **M^3/YR**
.24.9x	**OTHER** Phase 4 • Construct or install other ex situ chemical treatment. Phase 5 • Perform O&M activities such as inspecting the site, replacing materials, cleaning the area, and repairing other ex situ chemical treatment.	**M^3** **M^3/YR**
.25	**IN SITU PHYSICAL TREATMENT**	
.25.01	**IN-WELL AIR STRIPPING/ CIRCULATING WELLS** Phase 4 • This element includes using the circulating well (CW) technique for subsurface groundwater stripping by creating a three-dimensional circulating pattern of groundwater. Groundwater is drawn into a well through one screened section and is pumped through the well to a second screened section where it is reintroduced to the aquifer. The upward and downward flow can be redirected depending on site-specific conditions. Because groundwater is not pumped above the ground, the cost of operations is reduced. In addition, simultaneous treatment of the vadose zone is achieved in the form of bioventing and vapor extraction from the circulating well. CW systems can provide treatment inside the well, in the aquifer, or both. For in-well treatment, the contaminant must be adequately soluble and mobile so it can be recirculated. In-well treatment includes air stripping, activated carbon adsorption, and biodegradation. In situ treatment is achieved by enhancing aerobic biodegradation. Use Extraction Wells (X.18.01) and Injection Well (X.18.02.) for drilling and well development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting on the facility, clearing the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.25.02	**AIR SPARGING** Phase 4 • This element includes using sparging groundwater treatment technologies to remove organic contaminants by injecting air into the aquifer and allowing the air to pass upward into the unsaturated soil. Contaminants are removed either by partitioning into the moving air or through biodegradation enhanced by the introduction of dissolved oxygen from the injected air. The injected air to be captured by an SVE system. Air sparging equipment consists of an air compressor (usually an oil-less compressor), piping, and injection wells. Associated equipment includes instrumentation and controls and occasionally involves air filters and a heat exchanger. Phase 5 • This element includes operations and maintenance activities such as inspecting treatment units, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.25.03	**RESERVED FOR FUTURE USE**	
.25.04	**CRYOGENICS (FROZEN SOIL BARRIER)** Phase 4 • This element includes using a frozen soil barrier as a temporary in situ containment technology to isolate or prohibit migration of the contaminants by freezing the ground, thereby limiting contaminant movement in or out of the frozen area. Circulating refrigerant through dual-tube boreholes spaced around the area to be contained forms a 4-to 6-footthick barrier, which freezes the soil moisture and reduces permeability. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, cleaning the area, and repairing components.	**M^2** **M^3/YR**
.25.05	**FRACTURING (HYDROFRACTURING)** Phase 4 • This element includes using high-pressure injection of a water/sand mixture to create open fractures in low-permeability soils. Injected sand keeps fractures open, enabling contaminant removal and reagent addition. This will increase contaminant removal rates by creating a more permeable pathway for fluid and vapor. Applicable for removal of chlorinated organic and petroleum contamination from fine-textured soils, hydraulic fracturing can be coupled with thermally enhanced soil vapor extraction. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, preparing materials, cleaning the area, and repairing components.	**M** **M/YR**
.25.06	**LASAGNA PROCESS** Phase 4 • This element includes using the Lasagna process to remediate contaminated soils with very low permeability. The Lasagna process is a combination of process that includes electrokinetics to move the water and soluble contaminants in soil pores; chemical or biological treatment zones in which contaminants can be decomposed or adsorbed; and drilling or fracturing processes that allow the development of the treatment zones. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, cleaning the area, and repairing components.	**M^2** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.25.07	**LASER (CUTTING)** Phase 4 • This element includes using lasers to cut equipment, structures, and other items for removal and demolition. Operation of the laser is included in this activity. Phase 5 • This element includes cutting items during operations and maintenance.	 **M** **M**
.25.08	**LASER (SURFACE DECONTAMINATION)** Phase 4 • This element includes using lasers to remove contaminated layers of paint or coating without having to decontaminate the entire item. This element also includes the operation of the laser. Phase 5 • This element includes using lasers during facility operation and maintenance to remove contaminated layers of paint or coating without having to decontaminate the entire item. This element also includes the operation of the laser.	 **M^2** **M^2**
.25.09	**PASSIVE/REACTIVE TREATMENT WALL** Phase 4 • This element includes using a passive/reactive treatment wall as a barrier to a contaminated plume. These walls usually consist of a trench filled with reactive materials or electrochemical barrier constructed down gradient, in the path of a contaminated plume. As the trench intercepts the plume, the contaminated water passively travels through the reactive media that degrade the contaminants. A variety of reactive media (chemical or physical) can be used to treat or capture the contaminants. See X.21.01 for Biological Barrier. A common reactive barrier configuration is a funnel and gate that direct large volume of contaminated water through the reactive wall without the need for pumping. This element includes trenching or excavation activities. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment site, preparing chemicals or materials, cleaning the area, and repairing the barrier.	 **M^2** **M^2/YR**
.25.10	**SKIMMING** Phase 4 • This element includes using skimming to collect or remove material floating on contaminated liquids. Skimming devices include rotating arms, vacuuming devices, scrapers, special absorptive cloths, and other processes. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing equipment, cleaning the area, and repairing or replacing components.	 **M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.25.11	**SOIL FLUSHING (SURFACTANT/SOLVENT)** Phase 4 • This element includes using in situ soil flushing to extract contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer and, when possible, recycled. Use Extraction Wells (X.18.01) and Injection Wells (X.18.02.) for drilling and well development costs. Phase 5 • This element includes operations and maintenance activities such as inspecting the site, preparing chemicals, clearing the area, and repairing components.	**M^3** **M^3/YR**
.25.12	**SOLIDS DEWATERING/DRYING** Phase 4 • This element involves solids dewatering, any of a number of processes to remove water, moisture, liquids or fluids. These processes include open-air drying, enhanced evaporation through venting or heating in place, placing heavy loads on contaminated waste and collecting the leachate, and installing materials that enhance water movement in one direction. This element may also include drilling, piping, fans or air pumps, liquid pumps, electrodes for heating, vents for collecting off-gas, and related equipment. Phase 5 • This element includes operations and maintenance activities such as inspecting treatment unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.25.13	**RESERVED FOR FUTURE USE**	
.25.14	**VACUUM/BLASTING** Phase 4 • This element includes cutting or removing surface using high-pressure equipment with scouring materials such as ice pellets, carbon dioxide pellets, sand, water or other hard, abrasive, or corrosive materials. The contaminated materials are then collected using a vacuuming device. Phase 5 • This element includes operation and maintenance of the vacuuming and blasting equipment and systems including replacing parts and consumables, inspecting and cleaning equipment, repairing components, and other similar tasks.	**M^2** **M^2/YR**
.25.15	**COATING** Phase 4 • This element includes applying paints, adhesive substances, or bonding substances on structures or equipment to contain contaminants or to reduce exposure to contaminants. Phases 5 and 6 • This element includes the regular application of paints, adhesive substances, or bonding substances on structures or equipment to contain contaminants or to reduce exposure to contaminants as part of operation and maintenance or long-term monitoring activity.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.25.16	**ELECTROKINETICS** Phase 4 • This element includes using the electrokenetics process to remove metals and organic contaminants from low-permeability soil, mud, sludge, and marine dredging. When direct current is passed through low permeable soil, it mobilizes charged species, causing ions and water to move toward the electrodes. Positively charged ions and compounds move toward the cathode. Negatively charged ions and compounds move toward the anode. The current creates an acid front at the anode and a base front at the cathode. This generation of acidic condition in situ may help mobilize sorbed metal contaminants for transport to the collection system at the cathode. Two primary mechanisms transport contaminants through the soil towards one or the other electrodes: electromigration and electroosmosis. In electromigration, charged particles are transported through the substrate. In contrast, electroosmosis is the movement of a liquid containing ions relative to a stationary charged surface. Of the two, electromigration is the main mechanism for the electrokinetic treatment process. The direction and rate of movement of an ionic species will depend on the magnitude and polarity of its charge and the magnitude of the electroosmosis-induced flow velocity. Non-ionic species, both inorganic and organic, will be transported with the electroosmosis-induced water flow. This element includes electrodes, storage tanks, instrumentation and controls, and other miscellaneous items. See other technologies for processing the waste. Phase 5 • This element includes costs associated with operations and maintenance activities such as utility cost, treatment unit inspection, cleaning electrodes, and repairing components.	**M^3** **M^3/YR**
.25.17	**SOIL VAPOR EXTRACTION** Phase 4 • This element includes using soil vapor extraction (SVE) to remove volatile organic compounds from vadose zone soil by pulling air through the soil. The air is moved by means of a blower or vacuum placed in the soil through extraction wells. Associated equipment includes condensate handling devices, instrumentation and controls, and, in most cases, off-gas treatment geomembranes to prevent short-circuiting. The SVE process is distinct from vapor/gas venting and collection listed under Gas/Vapor Collection Trench System (X.16.01). Activities associated with SVE may include surface covering (placement of geomembranes) and Air Sparging (X.25.02). Phase 5 • This element includes operations and maintenance activities such as inspecting treatment unit, cleaning components, and repairing components.	**M^3** **M^3/YR**
.25.18	**FRACTURING (PNEUMATIC)** Phase 4 • This element includes using the pneumatic fracturing (PF) process to remove chlorinated organic and petroleum contamination from fine-textured soils. Fracture wells are drilled in the contaminated vadose zone and left open (uncased) for most of their depth. A packer system is used to isolate small (0.6-meter or 2-foot) intervals so that short bursts (approximately 20 seconds) of compressed air (less than 10,300 mm of Hg or 200 pounds per square inch) can be injected into the interval to fracture the formation. The process is repeated for each interval in the contaminated depth. Hydraulic fracturing can be coupled with thermally enhanced soil vapor extraction technologies to enhance performance. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, preparing materials, cleaning the area, and repairing components.	**M** **M/YR**

ECES #	ECES DESCRIPTION	UOM
.25.19	**BLAST ENHANCED FRACTURING** Phase 4 • This element includes using blast-enhanced fracturing at sites with fractured bedrock formations. The increased well yields, hydraulic conductivity values, and capture zones occur as a result of the highly fractured area created by detonation of explosives in boreholes. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, preparing materials, cleaning the area, and repairing components.	**M** **M/YR**
.25.20	**DIRECTIONAL WELLS (ENHANCEMENT)** Phase 4 • This element includes using directional wells, also known as horizontal wells, to position wells horizontally, or at an angle, to reach contaminants not accessible by direct vertical drilling. Directional drilling may be used to enhance other in-situ or in-well technologies such as groundwater pumping, bioventing, SVE, soil flushing, and in-well air stripping. Hardware used for directional boring includes wireline coring rigs, hydraulic thrust systems, electric cone penetrometers, steering tracking hardware, sonic drilling equipment, and push coring systems. Hydraulically activated thrust equipment capable of exerting more than 40 tons of thrust is used to push the directional boring heads into the earth. Directional control is obtained by proper positioning of the face of the non-symmetric boring head. Slow rotation of the boring head will cut and compact the geologic material into the borehole wall. Thrusting a non-rotating boring head will cause a directional change. The machinery is capable of initiating a borehole, steering down to a desired horizontal depth, continuing at that depth, and then steering back to the surface at a downrange location. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, preparing materials, cleaning the area, and repairing components.	**M** **EA/YR**
.25.21	**BIOSLURPING** Phase 4 • This element includes using the bioslurping process for recovering free-phase, light, non-aqueous-phase liquids (or contaminated groundwater from near the vadose zone/water table interface via vacuum enhanced pumping. This activity is often accomplished with a variable length suction pipe (for extracting liquids) inside a soil vapor extraction well. The screened interval of the soil vapor extraction well usually spans the vadose zone/water table interface. Soil vapor extraction and free product/groundwater extraction occur simultaneously; resulting in aeration of surrounding soil, which enhances biodegredation compounds amenable to biodegredation under aerobic conditions. This element includes drilling the well and equipment required for bioslurping, such as well casing, mainifold piping, suction piping (or drop tubes), vacuum pump(s) (often liquid-ring pumps), air/water separator(s), and oil/water separator(s). Extracted liquids and air may also require treatment. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, replacing materials or components, clearing the area, making repairs, and performing other activities to maintain the pumps and collect the contaminants.	**M^3** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.25.22	**DUAL PHASE EXTRACTION (MULTI-PHASE)** Phase 4 • This element includes using a high-vacuum system to simultaneously remove various combinations of contaminated liquids and gases from above and below the water table. This technology is known as multi-phase extraction or vacuum-enhanced extraction. Once above ground, the extracted vapors or liquid-phase organic and groundwater are separated and treated Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, replacing materials or components, clearing the area, making repairs, and performing other activities to maintain the pumps and collect the contaminants.	**M^3** **M^2/YR**
.25.23	**DRAWDOWN PUMPING** Phase 4 • This element includes using draw-down pumping to pump light, non-aqueous-phase liquid (LNAPL) and groundwater from recovery wells or trenches. Pumping removes water and lowers the water table near the extraction area to create a cone of depression. The cone of depression in the vicinity of the extraction well produces a gravity head that pushes flow of LNAPL toward the well and increases the thickness of the LNAPL layer in the well. Each foot of groundwater depression provides a driving head equivalent to a pressure difference of 0.45 psi. In most cases, the production of a cone of depression will increase LNAPL recovery rates. Pumping may be accomplished with one or two pumps. In the single-pump configuration, one pump withdraws both water and LNAPL. The two-pump configuration uses one pump located below the water table to remove water and a second pump located in the LNAPL layer to recover LNAPL. A single pump system reduces capital and operating costs and allows simpler control systems and operation but produces a stream of mixed water and LNAPL that must be separated. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, replacing materials or components, clearing the area, making repairs, and performing other activities to maintain the pumps and collect the contaminants.	**M^3** **M^3/YR**
.25.9x	**OTHER (USE NUMBERS 90-99)** Phase 4 • Construct or install other in situ physical treatment facilities. Phases 5 and 6 • Perform O&M activities such as inspecting equipment, replacing materials, clearing the area, and repairing in situ physical treatment equipment.	**M^3** **M^3/YR**
.26	**EX SITU PHYSICAL TREATMENT**	
.26.01	**AERATION** Phase 4 • This element includes using aeration to bring air and water, soil, sludge, or other contaminated media into contact to promote biological degradation or oxidation. Aeration can be accomplished by a variety of methods including tilling the land, air compressors, blowers, and sprinkler systems. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing feed materials, cleaning the area and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.02	**ADVANCED ELECTRICAL REACTOR** Phase 4 • This element using an advanced electrical reactor to incinerate wastes within a reactor core heated by electrically heated carbon electrodes (which are insulated by nitrogen gas). This element includes reactor ownership/rental, feeders for solids and nozzles for liquids, and post-reactor treatment. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing equipment, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.03	**AGGLOMERATION** Phase 4 • This element using agglomeration to transform sludge into dry, dense pellets by batch mixing sludge with an agglomeration agent. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.04	**AIR STRIPPING** Phase 4 • This element includes air stripping to physically transfer dissolved molecules from a liquid waste stream to a flowing gas. Air stripping is normally carried out as a continuous operation that employs a packed tower, where liquid waste is pumped near the top of a stripping column and flows down through an upward airflow. As the airflow contacts the liquid wastes, the volatile organic are stripped from the liquid waste. This element does not include extracting or pumping contaminated groundwater. Phase 5 • This element includes costs associated with operations and maintenance activities such as utility costs, treatment unit inspection, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.05	**CHELATION** Phase 4 • This element includes using chelation to remove toxic metals from soil, sludge, or liquids. Metals contained in the soil, sludge, or liquids are contacted with an aqueous solution containing a chelating agent. The resulting slurry is dewatered, or the chelating agent combined with the toxic metal is sent to a storage or treatment plant. Assemblies include conveyors, water or storage tanks, mixing devices, dewatering devices, and pumps and associated piping and valves. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit or reactor, preparing chemicals, cleaning areas, and repairing components.	**M^3** **M^3/YR**
.26.06	**RESERVED FOR FUTURE USE**	
.26.07	**COMPACTION/VOLUME REDUCTION** Phase 4 • This element includes using physical force to reduce the volume of solids, thereby easing handling, transportation, storage, and disposal of the waste. Phase 5 • This element includes operations and maintenance activities such as inspecting the compactor unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.08	**RESERVED FOR FUTURE USE**	
.26.09	**DECANT/PHASE SEPARATION** Phase 4 • This element involves using decant separation to separate liquids from the sediment that has settled to the bottom of the tank or basin. This element includes the cost of decant equipment, tanks (water, chemical, waste storage), instrumentation and controls, pumping or liquid transfer, and associated piping. Phase 5 • This element includes operations and maintenance activities such as inspecting the decant unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.10	**DISSOLVED AIR FLOATATION** Phase 4 • This element includes using dissolved air floatation as a pretreatment to separate suspended solids, oil, and grease from wastewater without using chemicals. Gas bubbles are brought out of solution and into contact with contaminants in the waste stream. These gas bubbles attach to the contaminants and lift them to the surface. Assemblies include pressurization units, discharge heads, associated piping, transfer pumps, and tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.11	**DISTILLATION** Phase 4 • This element includes using distillation to purify liquids through boiling so that the steam condenses to a pure liquid and the pollutants remain in a concentrated residue. The process involves two basic phases, the liquid phase and the vapor phase. The components to be separated by distillation are present in both phases but in different concentrations. If there are only two components in the liquid, one concentrates in the condensed vapor (condensate) and the other in the residual liquid. If there are more than two components, the less volatile components concentrate in the residual liquid and the more volatile in the vapor condensate. This element includes the cost of the distillation unit, cooling systems, piping, pumps, instrumentation and control, and other miscellaneous items. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.12	**E-BEAM** Phase 4 • This element includes using electron beam treatment technology to destroy organic-contaminated wastewater, soil, sediments, or sludge suspended in an aqueous matrix. The high-energy electron beam generates strongly reducing reactive species and strongly oxidizing reactive species at the same time and in almost the same concentration in the solution. The reactive transient initiates the chemical reactions that are capable of destroying hazardous compounds in aqueous solution, in most cases transforming them into carbon dioxide, water, and salt. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.13	**ELECTROCHEMICAL OXIDATION** Phase 4 • This element includes using electrochemical oxidation to create ions for electrochemically oxidizing aqueous organic liquid, organic liquid, and some organic solids into carbon dioxide and water. The process requires an electrochemical cell in which the anode and cathodes are present; electric current flows through the cell, causing chemical reaction in the electrolyte. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.14	**RESERVED FOR FUTURE USE**	
.26.15	**ELECTROLYSIS** Phase 4 • This element includes using electrolysis to oxidize substances at the anode and reduce substances at the cathode. Electrolysis is the process in which reduction and oxidation reactions take place at the surface of conductive electrodes immersed in an electrolyte under the influence of an applied potential. Assemblies include trough-shaped elongated cells, monitoring equipment, and anode and cathode material. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the electrolytes, and repairing components.	**M^3** **M^3/YR**
26.16	**EQUALIZATION** Phase 4 • This element includes using the equalization process in which collected wastewater is mixed to produce a homogenous solution that is discharged to a treatment plant. Blending is used to even out variations in contaminated soils and sludge, similar to equalization. Equalization is used to maintain stability and to reduce disruptions in a treatment system. Assemblies include mixers, aerators, discharging pumps, and equalization tank. Phase 5 • This element includes operations and maintenance activities such as inspection, cleaning, and repairing components.	**M^3** **M^3/YR**
.26.17	**EVAPORATION** Phase 4 • This element includes using evaporation to treat organic material that can be removed by heat or to reduce the volume of liquids or the high moisture content in wastes. Evaporation increases the concentration of contaminants in the waste media. Evaporation is usually conducted under vacuum conditions to reduce atmospheric pressure promotes evaporation. Or the surface area of the tank is increased to further promote evaporation. Assemblies include simple stills, flash and circulation evaporators, rotors, and heaters. Phase 5 • This element includes operations and maintenance activities such as inspection, cleaning, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.18	**SOIL VAPOR EXTRACTION** Phase 4 • This element includes using soil vapor extraction (SVE) to remove VOCs from soil by pulling air through the soil. The air/vapor is moved by means of a blower or vacuum pump connected to reactors or cells via piping. Or the excavated soil can be placed in a network of aboveground pippins to which a vacuum is applied to encourage volatilization of organics. Soil piles are generally covered with a geomembrane to prevent volatile emissions and to prevent the soil from becoming saturated by precipitation. Associated equipment includes condensate-handling devices, instrumentation and controls, and in most cases, off-gas treatment equipment. SVE differs from vapor/gas venting and collection listed under Gas/Vapor Collection Trench System (X.16.01). Activities associated with SVE may include Air Sparging (X.25.02). Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the components, and repairing components.	**M^3** **M^3/YR**
.26.19	**FILTER PRESSES** Phase 4 • This element includes using filter presses for sludge dewatering. Filter presses consist of chamber filter plates between which sludge is pumped. Under high pressure, the plates are forced together, which effectively dewaters the sludge. The resulting sludge cake is discharged from the filter press. Assemblies include filter press ownership/rental costs, sludge transfer and feed pumps, chemical feed and storage equipment, sludge storage and conditioning tanks, mixers, belt filter, vacuum filter, drying beds, and necessary pipe work. Phase 5 • This element includes operations and maintenance activities such as inspecting the filter press unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.20	**MEDIA FILTRATION** Phase 4 • This element includes using media filtration to separate microparticles suspended in a liquid or gaseous fluid by forcing the fluid through a porous medium. As the fluid passes through the medium, the suspended particles are trapped on the surface of the medium or within the body of the medium. The pressure differential to move the fluid through the medium can be induced by gravity, positive pressure, or vacuum application. The most common system for media filtration is through a layered bed of granular media, usually a coarse anthracite coal and sand. Phase 5 • This element includes operations and maintenance activities such as inspecting the filtration unit, cleaning or backwashing, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.21	**FREEZE CRYSTALIZATION** Phase 4 • This element includes using freeze crystallization to remove purified solvent from solution as frozen crystals. When a solution containing dissolved contaminants is slowly frozen, water ice crystals form on the surface, and the contaminants are concentrated in the remaining solution (called "mother liquor"). The ice crystals can be separated from the mother liquor, washed, and melted to yield a nearly pure water stream. The contaminated waste stream, mother liquor, and any precipitated solids, are generally more amenable to subsequent treatment by conventional destruction and stabilization technologies due to the higher concentrations. Phase 5 • This element includes operations and maintenance activities such as inspecting the crystallization unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.22	**RESERVED FOR FUTURE USE**	
.26.23	**GRANULAR ACTIVATED CARBON ADSORPTION - LIQUID** Phase 4 • This element includes using activated carbon adsorption to remove organic contaminants from liquid waste streams. Granular activated carbon is applied in a stationary column or filter bed where organic contaminants are adsorbed. Items associated with carbon adsorption are isotherm tests, granular activated carbon columns, pre-filters, and items associated with regenerating the spent carbon. Phase 5 • This element includes operations and maintenance activities such as inspecting the carbon unit, cleaning or regenerating the carbon, and repairing components.	**M^3** **M^3/YR**
.26.24	**HEAVY MEDIA SEPARATION** Phase 4 • This includes using heavy media separation to separate materials of differing density by float/sink in a colloidal suspension of a finely ground dense mineral. This suspension, or media, usually consists of a water-suspension of magnetite, galena, or ferrosilicon. Phase 5 • This element includes operations and maintenance activities such as inspecting the separation unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.26.25	**HIGH PRESSURE AQUEOUS DESTRUCTION** Phase 4 • This element includes using surface cleaning technologies that use water under high-pressure to remove contaminants from soils, solids, and structures. This process may be used in conjunction with surfactants and solvents for cleaning and decontamination. Ultrahigh-pressure water jet equipment can also be use as a cutting tool. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the unit, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.26	**LIGNIN ADSORPTION/SORPTIVE CLAYS** Phase 4 • This element includes using lignin adsorption/sorptive clays to treat aqueous waste streams with organic, inorganic, and heavy metals contamination. The waste stream is treated by the molecular adhesion of the contaminants to an adsorptive surface. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, and repairing components.	**M^3** **M^3/YR**
.26.27	**MAGNETIC SEPARATION** Phase 4 • This element includes using magnetic separation to extract slightly magnetic radioactive particles from host media such as water, soil, or air. All uranium and plutonium compounds are slightly magnetic while most host media are nonmagnetic. The process operates by passing contaminated fluid or slurry through a magnetized volume. The magnetized volume contains a magnetic matrix material such as steel wool or spherical steel balls that extract the slightly magnetic contamination particles from the slurry. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, cleaning the components, and repairing components.	**M^3** **M^3/YR**
.26.28	**MEMBRANE SEPARATION - ELECTRODIALYSIS** Phase 4 • This element includes using electrodialysis to remove dissolved salts, soluble silica, and organic materials from waste streams and to concentrate the dissolved heavy metal. Assemblies include water storage tanks, associated pumps, piping, and valves, and backwashing of contaminated membranes. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.29	**REVERSE OSMOSIS** Phase 4 • This element includes using reverse osmosis to remove dissolved salts, soluble silica, colloids, and organic molecules from waste streams. Wastewater is collected and sent through a reverse osmosis system under pressure (200-1200 psig). The reverse osmosis system first filters, then concentrates, waste materials while water easily passes through. The secondary waste (brine) needs to be treated further or disposed of. The membrane can be made of cellulose acetate, thin film composites, or various polymers. There are also several membrane configurations with varying membrane areas within the modules. Equipment includes reverse osmosis membranes, containment modules, chemical feed (usually acid), high-pressure pumps, storage tanks, piping, and instrumentation and controls. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, replacing components, and repairing equipment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.30	**OIL/WATER SEPARATION** Phase 4 • This element includes separating oil and water using the differences in their densities and gravitational pull. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.31	**SEDIMENTATION** Phase 4 • This element includes using sedimentation, a physical process by which particles suspended in a liquid are made to settle by means of gravitational and inertial forces acting on both the particles suspended in the liquid and the liquid itself. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.32	**SHREDDING** Phase 4 • This element includes shredding large solid wastes and process drums and their contents. Necessary equipment includes conveyors and rotary shear shredders. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.33	**SIEVING (SIZE SEPARATION, SCREENING, PHYSICAL SEPARATION)** Phase 4 • This element includes using sieves to separate smaller materials from larger materials. Physical separation is based on the fact that most organic and inorganic contaminants tend to bind, either chemically or physically, to the fine (i.e., clay and silt) fraction of a soil. The clay and silt soil particles are, in turn, physically bound to the coarser sand and gravel particles by compaction and adhesion. Thus, separating the fine clay and silt particles from the coarser sand and gravel soil particles effectively concentrates the contaminants into a smaller volume of soil that could then be further treated or disposed. Equipment includes conveyers, storage tanks, sieves or screens, and other equipment. This element also includes straining, contaminated water or wastewater to remove sludge and coarse solid materials. Items include in this element are pumps, piping, storage tanks, valves, and other equipment. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.34	**SKIMMING** Phase 4 • This element includes skimming to remove or collect floating material at the top of contaminated media. Skimming can be used to separate oil from water, liquid of different densities, solids for liquids, etc. Skimming devices include rotating arms, vacuuming devices, scrappers, belt skimmers or rope wicks made of oleophilic or hydrophobic material, a floating filter mesh with high affinity for non-polar hydrocarbons, and other devices. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.35	**SOIL WASHING (SURFACTANT/SOLVENT)** Phase 4 • This element includes soil washing as an ex situ separation technology that uses a fluid (usually water or water with wash-improving additives) to remove hazardous, toxic, or radioactive contaminants from excavated soils, sludge, and sediments. The soil is rinsed to remove any excess surfactants, while the liquids are treated as contaminated liquids. Assemblies include conveyors, screens, tanks, dewatering devices, associated piping and valves, and liquid waste treatment units. Refer to Soil Flushing (Surfactant/Solvent) (X.23.05), Glycolate Alkali Metal/Polyethylene Glycol (A/PEG) (X.24.01), Dehalogenation (Catalytic Dechlorination) (X.24.05), and Solvent Extraction (X.24.11) (which uses an organic chemical to dissolve, separate and concentrate organic contaminants) for in situ treatment. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.36	**SOLIDS DEWATERING/DRYING** Phase 4 • This element includes using solid dewatering to remove water, moisture, liquids, or fluids by filtration, centrifugation, open air drying, vacuum suction, or other mechanical or evaporative method. Dewatering or drying also reduces volume and, thereby, increases the ease of handling waste. Dewatered sludge is disposed of by burning or being sent to a landfill. This element does not include dewatering through the use of a filter press, see Filter Presses (X.26.19). Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.37	**SPRINKLER IRRIGATION** Phase 4 • This element includes using sprinkler irrigation to volatilize VOCs from contaminated wastewater. The process involves the pressurized distribution of VOC-laden water through a standard sprinkler irrigation system. Sprinkler irrigation transfers VOCs from the dissolved aqueous phase to the vapor phase, whereby the VOCs are released directly to the atmosphere. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.38	**SUPERCRITICAL EXTRACTION** Phase 4 • This element includes using supercritical extraction to dissolve organic constituents of a waste stream after mixing the waste with a gas (such as carbon dioxide, propane, or butane) pressurized to the supercritical state. The enhanced solubility of the fluid, due to the high pressures and temperatures, aid in the removal of the wastes. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.39	**SURFACTANT ENHANCED RECOVERY** Phase 4 • This element includes applying surfactant micelles or steam to the groundwater to facilitate groundwater pumping by increasing the mobility and solubility of the contaminants sorbed to the soil matrix. Surfactant micelles can also facilitate the entrainment of hydrophobic contaminants to allow removal and assures that multiphase contaminants can be effectively removed. Thus the process can increase the contaminant mass removal per pore volume of groundwater flushing through the contaminated zone. The implementation of surfactant-enhanced recovery requires the injection of surfactants into a contaminated aquifer. Typical systems use a pump to extract groundwater some distance from the injection point. The extracted groundwater is treated ex situ to separate the injected surfactants from the contaminants and groundwater. To be cost-effective, the design of the surfactant-enhanced recovery system is critical. When the surfactants have been separated from the groundwater, they can be re-injected into the subsurface. Contaminants must be separated from the groundwater and treated prior to discharge of the extracted groundwater. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment, replacing components, and repairing equipment**.**	**M^3** **M^3/YR**
.26.40	**SYNTHETIC RESIN ADSORPTION** Phase 4 • This element includes using synthetic resin absorption to absorb and capture contaminants onto a resin in a liquid or gaseous stream. Synthetic resins are more durable than natural adsorbents and provide large surface area and higher adsorption capacity for organic molecules**.** Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, regenerating resin, replacing components, and repairing equipment**.**	**M^3** **M^3/YR**
.26.41	**GRAVITY SEPARATION** Phase 4 • This element includes using gravity separation which relies on a density difference between phases, as a solid/liquid separation process. Equipment size and effectiveness of gravity separation depends on the settling velocity of the solid, which is a function of particle size, density difference, fluid viscosity, and particle concentration (hindered settling). Gravity separation is also used for removing immiscible oil phases and for classification where particles of different sizes are separated. It is often preceded by coagulation and flocculation to increase particle size, thereby allowing removal of fine particles. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.42	**CRYOGENICS** Phase 4 • This element includes using cryogenics to defuse unexploded munitions by freezing the munitions and destroying them by smashing the device and breaking them apart. This element includes equipment for freezing the munitions, facility for destroying the frozen munitions, and other auxiliary equipment. Phase 5 • This element includes operations and maintenance activities such as inspecting equipment, operating equipment, replacing components, and repairing equipment.	**EA** **EA/YR**
.26.43	**NANOFILTRATION** Phase 4 • This element includes using nanofiltration, a process similar to reverse osmosis, to remove certain dissolved salts, soluble silica, colloids, and organic molecules from liquid waste streams. Wastewater is collected and sent through a nanofiltration system under pressure, usually less than that of the reverse osmosis system (75-250 psi.). The nanofiltration system first filters, then concentrates, waste materials while water easily passes through. Equipment includes membranes, containment modules, chemical feed (usually acid), pressure pumps, instrumentation and control, and storage tanks. Treatment or disposal of the concentrate or brine is not included in this element. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, preparing chemicals, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.44	**ULTRAFILTRATION/MICROFILTRATION** Phase 4 • This element includes using ultrafiltration and microfiltration, low-pressure membranes (10-75 psi) to treat contaminated water and other liquids. This is the physical process whereby microparticles suspended in a liquid or gaseous fluid are separated by forcing the fluid through a porous membrane. As the fluid passes through the membrane, the larger suspended particles are trapped on the surface of the membrane. The size of the membrane pores varies and there are numerous membrane materials and configurations. Equipment includes membranes, containment modules, chemical feed (usually acid), pressure pumps, instrumentation and control, and storage tanks. Phase 5 • This element includes operations and maintenance activities such as inspecting the filtration unit, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.26.45	**MEMBRANE PERVAPORATION** Phase 4 • This element includes using membrane pervaporation, a process that uses permeable membranes that preferentially adsorb VOCs from contaminated water. Contaminated water first passes through a heat exchanger, raising the water temperature. The heated water then enters the pervaporation module, containing membranes composed of a nonporous organophilic polymer, similar to silicone rubber, formed into capillary fibers. VOCs diffuse by vacuum from the membrane-water interface through the membrane wall. Treated water exits the pervaporation module while the organic vapors travel from the module to a condenser where they return to the liquid phase. The condensed organic materials represent only a fraction of the initial wastewater volume and may be subsequently disposed of at a cost saving. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, operating the unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.26.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other ex situ physical treatment. Phase 5 • Perform O&M activities such as inspecting the facility, replacing materials, clearing the area, and repairing other ex situ physical treatment.	**M^3** **M^3/YR**
.27	**IN SITU THERMAL TREATMENT**	
.27.01	**THERMAL BLANKET (WITH VACUUM EXTRACTION)** Phase 4 • This includes using a thermal blanket to vaporize contaminants by heating soils to the boiling point of the contaminant. Contaminated vapors are then drawn out of the soil by a vacuum unit and treated in an off-gas unit. A thermal blanket comprises a steel box with a layer of steel webbing at the bottom. Heating elements, through which heat is transferred to the soil below, are woven. The blanket is placed above the contaminated soil, and a layer of vermiculite insulation is placed 12-18 inches above the blanket. This ensures a complete seal between the blanket and the contaminated soil. Thermal blankets are effective on contaminants located to a depth of approximately 3 feet. Phase 5 • This element includes the operations and maintenance of the treatment unit. Activities include monitoring the equipment and processes, replacing consumable materials, and replacing parts.	**M^2** **M^2/YR**
.27.02	**SIX-PHASE HEATING AND EXTRACTION** Phase 4 • This element combines six-phase soil heating with soil vapor extraction. Six-phase electrical heating splits conventional three-phase electricity into six electrical phases, producing an improved subsurface heat distribution. Heating raises the vapor pressure of volatile and semi-volatile contaminants, increasing the removal capabilities of the soil vapor extraction system. Heating also dries the soil and creates steam, which increases permeability and strips contaminants that may not be removed by the conventional soil vapor extraction system. Phase 5 • This element includes the operations and maintenance of the treatment unit. Activities include monitoring the equipment and processes, replacing consumable materials, and replacing parts.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.27.03	**RESERVED FOR FUTURE USE**	
.27.04	**STEAM/HOT WATER INJECTION VACUUM EXTRACTION** Phase 4 • This element includes using in situ steam extraction to remove hydrocarbons from contaminated soils by the continuous pumping of steam and heated compressed air and the recovery of the subsequently contaminated water and off-gas. The resultant air-stream is treated (by carbon adsorption, catalytic oxidation, or other means), compressed, and returned to the soil being treated. The condensed water is removed from the liquid stream with a gravity separator followed by treatment to remove dissolved organics. The condensed organics are collected and held for recycling or disposal. Assemblies include drilling injection and extraction wells and vacuum pumps. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy also is included.	**M^3** **M^3/YR**
.27.05	**HIGH TEMPERATURE THERMAL DESORPTION** Phase 4 • This element includes using high-temperature thermal desorption to heat (directly or indirectly) contaminated media such as soil, sediments, sludge, and filter cakes to 315 ^{o}C-537^{o}C (600 °F-1000 °F), driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation, or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system instrumentation and controls, bag houses, scrubbers, and treated- material handling systems. At high temperatures, decontaminated soil may not retain its physical properties and components in the soil may be damaged, which usually prevents treated soil from supporting future biological activity**.** Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy also is included**.**	**M^3/YR** **M^3/YR**
.27.06	**RESERVED FOR FUTURE USE**	
.27.07	**LOW TEMPERATURE THERMAL DESORPTION** Phase 4 • This element includes using low-temperature thermal desorption to heat (directly or indirectly) contaminated media such as soil, sediments, sludge and filter cakes to 93°C to 315°C (200°F-600°F), driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation, or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system instrumentation and controls, bag houses, scrubbers, and treated-material handling systems. At low temperatures, decontaminated soil retains its physical properties and components in the soil are not damaged, which enables treated soil to retain the ability to support future biological activity**.** Phase 5 • This element includes operations and maintenance activities such as inspecting treatment units, replacing components, and repairing equipment. The cost of energy is included.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.27.08	**RADIOFREQUENCY/ELECTROMAGNETIC HEATING** Phase 4 • This element includes using radio frequency/magnetic heating to remove contaminants such as oil, gasoline, diesel fuel, carbon tetrachloride, hexane, chloroform, and other constituents from liquid containing soils and solids at elevated temperatures (100°C-400°C). To implement the radiofrequency heating technology, electrodes must be placed in a borehole in the ground. Components also include vapor extraction tubes or piping, vapor barrier, condenser/ coolers, gas/liquid separator, storage tanks, off-gas treatment unit, pumps and blowers, and instrumentation and controls. Phase 5 • This element includes operations and maintenance activities such inspecting the equipment, and replacing consumables and components. The cost of energy and other utilities is included.	**M^3** **M^3/YR**
.27.9x	**OTHER** Phase 4 • Construct or install other in situ thermal treatment units. Phase 5 • Perform O&M activities such as inspecting the unit, replacing materials, clearing the area, and repairing other in situ thermal treatment units.	**M^3** **M^3/YR**
.28	**EX SITU THERMAL TREATMENT**	
.28.01	**HIGH TEMPERATURE THERMAL DESORPTION** Phase 4 • This element includes using high-temperature thermal desorption to heat (directly or indirectly) contaminated media such as soil, sediments, sludge, and filter cakes to 315°C-538°C (600°F-1000°F), driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation, or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system instrumentation and controls, bag houses, scrubbers, and treated-material handling systems. At high temperatures, decontaminated soil may not retain its physical properties and components in the soil may be damaged, which usually prevents treated soil from supporting future biological activity. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy is included.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.28.02	**INCINERATION** Phase 4 • This element includes using incineration technologies to destroy wastes by burning them in combustion chambers and using energy recovery devices. Incineration technologies include fluidized bed, rotary kiln, multiple hearth, infrared, circulating bed, liquid injection, pyrolysis, plasma torch, and wet air oxidation. Incineration is accomplished by oxidative or pyrolytic methods in the combustion chamber. Auxiliary equipment includes shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated-material handling systems. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy is included with this element.	**M^3** **M^3/YR**
.28.03	**LOW TEMPERATURE THERMAL DESORPTION** Phase 4 • This element includes using low-temperature thermal desorption to heat (directly or indirectly) contaminated media such as soil, sediments, sludge and filter cakes to 93°C-315°C (200°F-600°F), driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation, or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system instrumentation and controls, bag houses, scrubbers, and treated-material handling systems. At low temperatures, decontaminated soil retains its physical properties and components in the soil are not damaged, which enables treated soil to retain the ability to support future biological activity. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy is included.	**M^3** **M^3/YR**
.28.04	**MOLTEN SALT OXIDATION** Phase 4 • This element includes using molten salt destruction, which combusts waste materials in a bed of molten salt. Wastes are fed into a vessel containing molten salt and air; the high rate of heat transfer to the wastes causes destruction. Melt removal can be continuous or in batch mode. A variety of salts are used; the most common are sodium carbonate and potassium carbonate. Assemblies for molten salt destruction include salts, incinerators, storage systems, filtration systems, dewatering pretreatment systems, and a secondary reactor and cleanup system for off-gases. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. The cost of energy is included.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.28.05	**OPEN BURN AND OPEN DETONATION** Phase 4 • This element includes using open burn (OB) and open detonation (OD) operations to destroy excess, obsolete, or unserviceable (EOU) munitions and energetic materials. In OB operations, energetics or munitions are destroyed by self-sustained combustion, which is ignited by an external source such as flame, heat, or a detonation wave. An auxiliary fuel may be added to initiate and sustain the combustion of materials. In OD operations, detonatable explosives and munitions are destroyed by a detonation, which is generally initiated by the detonation of an energetic charge. Phase 5 • This element includes operations and maintenance activities such as inspecting the site. The cost of energy is included.	**M^3** **M^3/YR**
.28.06	**PLASMA** Phase 4 • This element includes incinerating or vitrifying processes that use plasma or an electrically neutral, highly ionized gas composed of ions, electrons, and neutral particles to generate the heat to destroy organic and inorganic material. Plasma torches use electricity to create and maintain enough heat (in excess of 5000^oC) to vaporize and destroy organic materials and inorganic materials are retained in a molten bath. Plasma processes usually cannot treat solids. This element includes reactor and auxiliary equipment such as shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated-material handling systems. An off-gas system removes particulates, organic vapors, and volatilizes metals. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.28.07	**PYROLYSIS** Phase 4 • This element includes using pyrolysis to transform hazardous organic materials into gaseous components, small quantities of liquid, and a solid residue (coke) containing fixed carbon and ash. Pyrolysis is the chemical decomposition induced in organic materials by heat in the absence of oxygen. In practice, it is not possible to achieve a completely oxygen-free atmosphere; actual pyrolytic systems are operated with less than stoichiometric quantities of oxygen. Because some oxygen will be present in any pyrolytic system, nominal oxidation will occur. If volatile or semi-volatile materials are present in the waste, thermal desorption will occur. Pyrolysis typically occurs under pressure and at operating temperatures above 430°C (800°F). Pyrolysis of organic materials produces combustible gases, including carbon monoxide, hydrogen, methane, and other hydrocarbons. The off-gases may be treated in a secondary combustion chamber, flared, and partially condensed. Particulate removal equipment such as fabric filters or wet scrubbers are also required. Pyrolysis minimizes the production of flue gases as compared to oxidation. Conventional thermal treatment methods, such as rotary kiln, rotary hearth furnace, or fluidized bed furnace, are used for waste pyrolysis. Kilns or furnaces used for pyrolysis are physically similar to incinerator equipment but would operate at lower temperature and with less air supply than would be required for combustion. Molten salt processes may also be used for waste pyrolysis. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**
.28.08	**RESERVED FOR FUTURE USE**	
.28.09	**RETORT/AMALGAMATION** Phase 4 • This element includes using retort/amalgamation for the removal and recovery of mercury. The contaminated medium is heated to volatilize the contaminants. The contaminants are captured or recovered by reacting with another metal, such as gold, or chemicals that can stabilize or convert the contaminants to highly insoluble forms. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**
.28.10	**SOLAR DETOXIFICATION/EVAPORATION** Phase 4 • This element includes using solar detoxification to photolytically degrade vaporized soil contaminants in a solar reactor into which sunlight is focused by a parabolic mirror array. The vaporized contaminants flow into the reactor after being desorbed from the soil when the latter is heated to about 400°C (750°F). Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.28.11	**STEAM STRIPPING/FLUSHING/REFORMING** Phase 4 • This element includes using steam stripping to physically transfer dissolved molecules from a liquid waste stream to a vapor stream. Steam stripping is normally carried out as a continuous operation that employs a conventional fractional distillation column where preheated wastewater is pumped near the top of the distillation column and flows downward through a flow of steam rising from the column bottom. As the steam contacts the liquid wastes, the volatile organics are stripped from the liquid waste and carried to a condenser in a water-cooled heat exchanger and collected in an accumulator tank. Secondary waste treatments (e.g., off-gas), if not part of the unit, but are costed using other treatment technologies. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**
.28.12	**SUPERCRITICAL WATER OXIDATION** Phase 4 • This element includes using supercritical water oxidation to improve the solubility of organic substances and salts. This process is also referred to as Supercritical Wet Oxidation and Supercritical Wet-Air Oxidation. This technology oxidizes organics at various concentrations with air, oxygen, or other oxidants, in the presence of high concentrations of water at temperatures and pressures above the critical point water. The critical point is where vapor and liquid occur. Oxidation is usually conducted at 400°C-650^{o}C under 253x10^{5} psi. Above the critical temperature and pressure, the properties of water are quite different from those of normal liquid or atmospheric steam. Under these conditions chemicals such as organic substances are completely soluble in water under some supercritical conditions and salts are almost insoluble under other supercritical conditions. Reactors that can withstand the temperature, pressure, corrosive aspects of the system, heat exchanger, and air compressor are key components. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**
.28.13	**THERMALLY ENHANCED VAPOR EXTRACTION** Phase 4 • This element includes using steam/hot-air injection or electrical resistance, electromagnetic, fiber-optic, or radio-frequency heating to increase the volatilization rate of semi-volatiles and facilitate their extraction. The process is similar to Soil Vapor Extraction but requires heat resistant components. Key components include reactor, coolers/condensers, off-gas treatment equipment, pumps and air blowers, particulate filters, instrumentation and controls, and piping. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment. This element also includes the cost of energy.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.28.14	**MOLTEN METAL** Phase 4 • This element, also known as the Catalytic Extraction Process (CEP) includes using a bath of molten metal as a solvent to reduce hazardous, toxic, and radioactive liquid, slurries, and solid waste to their basic elements. With the addition of select reactants, these elements can be recombined to form valuable gases, ceramics, and metals that can be used by industry. CEP differs from incineration or other thermal treatment technologies because it does not rely on flame combustion to alter the character and composition of waste. Instead, CEP relies on the catalytic properties of the molten metal to dissolve waste compounds. The equipment includes waste preparation facility to store, sort, and reduce size of waste; sealed environment processing tank; instrumentation and controls to monitor the process; and off-gas collection and treatment unit. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, repairing equipment, and cleaning the area. This element also includes the cost of energy.	**M^3** **M^3/YR**
.28.15	**HOT GAS DECONTAMINATION** Phase 4 • This element involves raising the temperature of the contaminated equipment or material to 260°C (500°F) for a specified period of time to decontaminate materials. The gas effluent from the material is treated in an afterburner system to destroy all volatilized contaminants. The method eliminates a waste that is stockpiled and requires disposal as a hazardous material and permits reuse or disposal of scrap as non-hazardous material. Hot-gas decontamination can also be used for decontaminating explosives, masonry, or metallic structures. The method involves sealing and insulating the structures, heating them with a hot-gas stream to 260°C (500°F) for a prescribed period of time, volatilizing the explosive contaminants, and destroying them in an afterburner. Operating conditions are site-specific. Contaminants are completely destroyed. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, replacing components, and repairing equipment.	**M^3** **M^3/YR**
.28.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construction or installation of other ex situ thermal treatment. Phase 5 • Perform O&M activities such as inspecting the unit, replacing materials, clearing the area, and repairing equipment.	**M^3** **M^3/YR**
.29	**IN SITU STABILIZATION/FIXATION/ENCAPSULATION**	
.29.01	**ASPHALT-BASED ENCAPSULATION** Phase 4 • This element includes using asphalt-based encapsulation to form a matrix encapsulating contaminated liquid or solid wastes. The process entails mixing waste and asphalt and heating them until they fuse in a stable matrix. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing chemicals, and repairing components.	**M^3** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.29.02	**GROUT INJECTION** Phase 4 • This element includes injecting grout directly into contaminated soil to prevent migration of the contaminants. Grouting will fill pores or seal voids that allow for infiltration of fluid and reduce pathways for contaminant transport. Grouting also encapsulates the contaminated soil. In most applications, cement is used for grouting applications. Assemblies include pumps for liquids or slurries, storage silos, weigh feeders, piping, mixers. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing chemicals, and repairing components.	**M^3** **M^2/YR**
.29.03	**POZZOLAN PROCESS** Phase 4 • This element includes using an in situ pozzolan process for in-place encapsulation of waste material by combining pozzolanic (siliceous) material, lime, or Portland cement with water to form a concrete-like solid. Pozzolanic material includes fly ash, blast-furnace slag, and cement kiln dust. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing chemicals, and repairing components.	**M^3** **M^2/YR**
.29.04	**IN SITU VITRIFICATION** Phase 4 • This element includes using in situ vitrification for in-place encapsulation of contaminated soils and sludge into a solid, glassy matrix by using large amounts of electrical current to melt the soil. The heat destroys most organics and captures inorganics in glass. Assemblies include electrical generators, electrical power distribution, electrodes, graphite placed over the soil to establish a conductive path, and an exhaust hood system to capture gaseous wastes. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components.	**M^3** **M^2/YR**
.29.05	**IN SITU PIPE GROUTING** Phase 4 • This element includes pumping grout into existing pipes, including manholes, to prevent access, introduction, or entrance of contaminants.	**M^3**
.29.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other in situ stabilization/fixation/encapsulation treatment facility. Phase 5 • Perform O&M activities such as inspecting the facility, replacing materials, clearing the area, and making repairing the stabilization/fixation/encapsulation treatment facility.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.30	**EX SITU STABILIZATION/FIXATION/ENCAPSULATION**	
.30.01	**ASPHALT-BASED ENCAPSULATION** Phase 4 • This element includes using asphalt-based encapsulation to form a matrix encapsulating contaminated liquid or solid wastes. The process entails mixing waste and asphalt, placing the mixture in a mold, and heating it until the waste and asphalt fuse in a stable matrix. Asphalt-based encapsulation includes dewatering, organic polymers, lime, kiln dust, or Portland cement. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing chemicals, and repairing components.	**M^3** **M^3/YR**
.30.02	**CALCINATION** Phase 4 • This element includes using calcination to vaporize water in the waste and transform chemicals in the waste to calcine particles. Calcination is a solidification technology in which liquid waste is placed in a calcinator cell heated to 500°C (932°F) by the combustion of oxygen and kerosene. The off-gas from the calcinator is passed through a combination of dry and wet clean-up systems before being released into the atmospheric. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components. This element also includes the cost of energy.	**M^3** **M^3/YR**
.30.03	**POLYMER BASED ENCAPSULATION** Phase 4 • This element includes using polymer encapsulation systems to incorporate waste residues in polyethylene jackets (thermoplastic polymers). Systems also consist of monomers or prepolymers that are polymerized or crosslinked by the use of catalysts or accelerators after being mixed with liquid wastes (polymerization systems). Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components.	**M^3** **M^3/YR**
.30.04	**POZZOLAN PROCESS (LIME/PORTLAND CEMENT)** Phase 4 • This element includes using pozzolanic (siliceous) material mixing lime, or Portland cement, and water to form a concrete-like solid matrix in which the waste is encapsulated. Batch mixers or pugmills are routinely used for the mixing waste material, pozzolanic material, and water. Pozzolanic material includes fly ash, ground blast-furnace slag, and cement kiln dust. This element does not include excavating and transporting contaminated material; see Solids/Soils Containment, Collection, or Control (X.19.xx) and Liquid Waste /Sludges Containment, Collection, or Control (X.20.xx). Phase 5 • This element includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities.	**M^3** **M^3/YR**
.30.05	**RESERVED FOR FUTURE USE**	

ECES #	ECES DESCRIPTION	UOM
.30.06	**SLUDGE STABILIZATION (AGGREGATE/ROCK/SLAG)** Phase 4 • This element includes using sludge stabilization for the solidification of contaminated wastes using aggregate and rock and slag additives to form a uniform, stable matrix to encapsulate waste materials. Sludge stabilization includes pumps for liquids or slurries, conveyors for sludge or solids, storage silos, weigh feeders, piping, mixers, and disposal or storage. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components.	**M^3** **M^3/YR**
.30.07	**VITRIFICATION/MOLTEN GLASS** Phase 4 • This element includes using vitrification to destroy combustible, hazardous, organic and inorganic wastes and/or melting the contaminants, capturing them in the molten glass. During the process, a pool of molten glass is developed and maintained by a passing a high-voltage electrical current between submerged electrodes. Combustible gases, mixed with air, ignite and react above the molten glass. Solids and noncombustible materials are incorporated into the glass bed, while gases are pulled out of the chamber through a series of filters. Assemblies include pretreatment systems (evaporation and sedimentation), conveyors, sumps to collect settling particles, and heat recovery and air pollution control systems. This element does not include excavating and transporting contaminated material; see Solids/Soils Containment, Collection or Control (X.19.xx) and Liquid Waste /Sludges Containment, Collection, or Control (X.20.xx). Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components. This element also includes the cost of energy.	**M^3** **M^3/YR**
.30.08	**MODIFIED SULFUR CEMENT** Phase 4 • This element includes using modified sulfur cement, commercially available thermoplastic material, to solidify contaminated materials. Cement is melted (at 127 °C-149°C [260 °F-300 °F]) then mixed with the waste to form a homogenous molten slurry that is discharged into suitable containers for cooling, storage, and disposal. Sulfur dioxide and hydrogen sulfide emissions are limited to allowable threshold values by the relatively low temperatures. A variety of common mixing devices, such as, paddle mixers and pug mills, can be used. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components. This element also includes the cost of energy.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.30.09	**POLYETHYLENE EXTRUSION** Phase 4 • This element includes using the polyethylene extrusion process to mix polyethylene binders and dry waste materials using a heated cylinder containing a mixing/transport screw. The heated, homogenous mixture exits the cylinder through an output die into a mold, where it cools and solidifies. Polyethylene's properties produce a very stable, solidified product. The process has been tested on nitrate salt wastes at plant-scale, establishing its viability, and on various other wastes at the bench and pilot scale. Equipment needed includes waste-drying or -heating unit, conveyers and feeders, mixing tank and mixer, extruder, storage tanks, and off-gas treatment unit. Phase 5 • This element includes operations and maintenance activities such as monitoring the process, preparing additives, and repairing components. This element also includes the cost of energy.	**M^3** **M^3/YR**
.30.10	**EMULSIFIED ASHPHALT** Phase 4 • This element includes using asphalt emulsification to transfer waste in water to an asphalt solid that is impermeable to water. Asphalt emulsions are very fine droplets of asphalt, dispersed in water, that are stabilized by chemical emulsifying agents. The emulsions are available as either cationic or anionic emulsions. The emulsified asphalt process involves adding emulsified asphalt having the appropriate charge to hydrophilic liquid or semi-liquid wastes at ambient temperature. After mixing, the emulsion breaks, the water in the waste is released, and the organic phase forms a continuous matrix of hydrophobic asphalt around the waste solids. In some cases, neutralizing agents, such as lime or gypsum, may be required. After setting and curing, the waste is uniformly distributed throughout the resulting solid asphalt, which is impermeable to water. Phase 5 • This element includes operations and maintenance activities such as process monitoring the process, preparing additives, and repairing components.	**M^3** **M^3/YR**
.30.9x	**OTHER (Use Numbers 90-99)** Phase 4 • Construct or install other ex situ stabilization/fixation/encapsulation treatment facility. Phase 5 • Perform O&M activities such as inspecting the facility, replacing materials, clearing the area, and repairing the stabilization/fixation/encapsulation treatment facility.	**M^3** **M^3/YR**
.31	**FACILITY DECOMMISSIONING & DISMANTLEMENT**	
.31.01	**NUCLEAR FACILITY SHUTDOWN AND INSPECTION** Phase 4 • This element includes activities such as plant shutdown and inspection, shutdown of unnecessary equipment, compilation and verification of as-built drawings, and other general housekeeping activities. Phase 5 • This element includes costs for operating and maintaining the equipment for facility shutdown and inspection.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.31.02	**DEACTIVATION** Phase 4 • This element includes preparing to place a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program to protect workers, the public, and the environment until decommissioning is complete. This process includes removing fuel, draining and/or de-energizing nonessential systems, removing stored radioactive and hazardous materials, and related actions. Phase 5 • This element includes costs for operating and maintaining the equipment for the activities described in Phase 4.	**M^2** **M^2/YR**
.31.03	**PREPARATION FOR DORMANCY** Phase 4 • This element includes activities to prepare the nuclear facility for dormancy after it has been stabilized, shut down, and deactivated. Activities include ensuring that equipment/components/systems are turned off and isolated and that tanks and drains are emptied, cleaned, and isolated; locking and tagging out equipment and components; monitoring and setting up alarm systems; and securing the area and equipment. Phase 5 • This element includes monitoring, surveillance, and inspection activities to ensure that the nuclear facility is safe, is not releasing contaminants, and is in a non-nuclear critical state.	**M^2** **M^2/YR**
.31.04	**HOT CELL EQUIPMENT MODIFICATION** Phase 4 • This element includes sealing and isolating equipment in the hot cell, such as gloveports, bagout ports, bulkhead electrical fittings, inlet filters, and other penetrations into the glovebox, to prevent contamination spread. Phase 5 • This element includes maintaining sealed equipment.	**M^2** **M^2/YR**
.31.05	**SITE RECONFIGURATION, ISOLATING AND SECURING STRUCTURE** Phase 4 and 5 • This element includes removing obstacles to dismantlement such as other projects or facilities/structures; creating barriers to intrusion; and ensuring structural integrity of foundations, walls, framing, ceilings, decking, roofs, cover blocks, platforms, and other items.	**M^2**
.31.06	**REMOVAL OF FUEL HANDLING EQUIPMENT** Phase 4 • This element includes dismantling and removing fuel-handling equipment including fuel positioning systems, cranes, and rigs. Phase 5 • This element includes operations and maintenance costs of fuel-handling removal equipment.	**LS** **LS/YR**
31.07	**RADIOLOGICAL INVENTORY CATEGORIZATION FOR D&D** Phase 4 and 5 • This element includes developing an estimate of radionuclide quantities presents in the facility and the nature of their principal physical and chemical forms. Apart from spent fuel, the radiological inventory can be divided into two categories: (1) activation of structural materials and (2) surface contamination. This contamination may consist of activated corrosion products, fuel fragments, and/or fission products.	**LS**

ECES #	ECES DESCRIPTION	UOM
.31.08	**DECONTAMINATION OF AREA AND EQUIPMENT** Phase 4 • This element includes locating all surface contamination on walls, floors, and equipment; constructing equipment; and treating, stabilizing, or removing all contamination using techniques such as chemical extraction, coatings, lasers, physical methods, thermal methods, vacuuming/blasting, and washing. Phase 5 • This element includes costs for operating and maintaining the equipment to treat, stabilize, or remove all contamination on walls, floors, and equipment.	**M^2** **M^2/YR**
.31.09	**DISMANTLING AND REMOVAL OF CONTAMINATED EQUIPMENT/MATERIAL** Phase 4 and 5 • This element includes cutting, sizing, and removing contaminated equipment, instrument tubing, piping, tanks, structures, stacks, and other components.	**M^2**
.31.10	**DISMANTLING OPERATIONS ON REACTOR VESSEL & INTERNALS** Phase 4 • This element includes removing the reactor pressure vessel, internal and attached piping, control rods, assemblies, instrumentation, and other internal components. Phase 5 • This element includes operations and maintenance of dismantling equipment.	**EA** **EA/YR**
.31.11	**DISMANTLING AND REMOVAL OF PRIMARY AND AUXILIARY SYSTEMS** Phase 4 • This element includes removing the primary and auxiliary systems that include components such as piping, pumps, instrumentation, moisture separators, condensers, and shielding. Phase 5 • This element includes operations and maintenance of removal equipment.	**M^2** **M^2/YR**
.31.12	**DISMANTLING AND REMOVAL OF BIOLOGICAL AND THERMAL SHIELD** Phase 4 • This element includes removal of the absorbing material placed around a reactor or radioactive source that is intended to reduce radiation levels. Phase 5 • This element includes operations and maintenance of removal equipment.	**M^2** **M^2/YR**
.31.13	**REMOVAL OF POOL LININGS** Phase 4 • This element includes removing linings from spent fuel pools, which includes remote dismantlement of the steel lining. Phase 5 • This element includes operations and maintenance of removal equipment.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.31.14	**DISMANTLING OF IN-CELL EQUIPMENT** Phase 4 • This element includes dismantling hot cells including removing lead glass windows, internal remote-operated cranes and hoists, manipulators, tongs, glove ports, liquid and gas piping, electrical outlets, pass-through, fire suppression equipment, lighting, ventilation, and other equipment. Phase 5 • This element includes operations and maintenance of removal equipment.	**EA** **EA/YR**
.31.15	**REMOVAL OF OTHER MATERIAL AND EQUIPMENT FROM CONTAINMENT STRUCTURE** Phase 4 • This element includes removing all material and equipment not specified previously. Phase 5 • Operate and maintain equipment used to remove all material and equipment not specified previously.	**M^2** **M^2/YR**
.31.16	**FACILITY (CONTROLLED AREA) HARDENING, ISOLATION, OR ENTOMBMENT** Phase 4 • This element includes encasing radioactive materials in concrete or other structural material sufficiently strong and structurally long-lived to ensure retention of the radioactivity until it has decayed to levels that permit restricted release of the site. Phase 5 • This element includes operations and maintenance of equipment to perform hardening, isolation, or entombment.	**M^3** **M^2/YR**
.31.17	**REMOVAL OF ALL OTHER FACILITIES, OR ENTIRE CONTAMINATED FACILITY** Phase 4 • This element includes final takedown of the facility using shears, wrecking balls, rams, bulldozers, implosion, or other technique/equipment. Phase 5 • Operate and maintain removal equipment, inspect and clean the area, and replace consumables.	**M^2** **M^2/YR**
.31.18	**DISMANTLING OF TEMPORARY FUEL STORAGE FACILITY** Phase 4 • This element include the final takedown of the temporary fuel-storage facility using shears, wrecking balls, rams, bulldozers, or other technique/equipment. Phase 5 • Operate and maintain removal equipment.	**M^2** **M^2/YR**
.31.19	**DISMANTLING OF INTERMEDIATE FUEL STORAGE FACILITY** Phase 4 • This element includes the final takedown of the intermediate fuel-storage facility using shears, wrecking balls, rams, bulldozers, or other technique/equipment. Phase 5 • Operate and maintain removal equipment.	**M^2** **M^2/YR**

ECES #	ECES DESCRIPTION	UOM
.31.20	**REPROCESSING COSTS** Phase 4 • This element includes the costs of reprocessing the equipment, components, and other materials for reuse.	**M^3**
.31.21	**DISMANTLING AND DEMOLITION OF OTHER FACILITIES** Phase 4 • This element includes dismantling and demolishing contaminated treatment, storage, or disposal facilities using shears, wrecking balls, rams, bulldozers, or other technique/equipment. Phase 5 • Operate and maintain removal equipment.	**M^2** **M^2/YR**
.31.9x	**OTHER** Phases 4 and 5 • This element includes all other activities involved in decommissioning and dismantlement not described by the above-listed categories.	**M^2**
.32	**MATERIAL HANDLING/TRANSPORTATION**	
.32.01	**WASTE STREAM HANDLING/PACKAGING** Phase 1 to 4 • This element includes lifting, packaging, and removing materials generated or removed from the environment. Systems that can aid in handling operations include automatic guided vehicles, palletizing robots, cranes, hoists, elevators, and conveyors. Waste is packaged in storage containers, receptacles, transportation packages, a major part of the transportation vehicle, or some other waste package. Phase 5 • Operate and maintain handling equipment.	**M^3** **M^3/YR**
.32.02	**TRANSPORTATION DEVICE/EQUIPMENT** Phase 1 to 4 • This element includes procuring transportation devices/equipment such as railroads, trucks, and barges. Phase 5 • Operate and maintain transportation devices/equipment.	**EA** **EA/YR**
.32.03	**OE OFF-SITE DESTRUCTION/TRANSPORTATION TO DOD FACILITY** Phase 1 to 4 • This element includes destroying OE at an off-site location or DoD facility. Phase 5 • Operate and maintain transportation devices/equipment and OE destruction.	**M^3** **LS/YR**
.32.04	**RESERVED FOR FUTURE USE**	
.32.05	**RESERVED FOR FUTURE USE**	
.32.06	**RESERVED FOR FUTURE USE**	
.32.07	**RESERVED FOR FUTURE USE**	
.32.09	**RESERVED FOR FUTURE USE**	
.32.10	**RESERVED FOR FUTURE USE**	
.32.10	**CERTIFICATION AND SHIPPING** Phase 1 to 5 • This element includes preparing and obtaining certifications and permits needed to ship and transport equipment/material to storage/treatment/disposal locations. This element also includes packaging, loading, unloading, and hauling waste short distances.	**EA**

ECES #	ECES DESCRIPTION	UOM
.32.11	**TRANSPORTATION BY TRUCK** Phase 1 to 5 • This element includes trucking soil, liquid, solids, equipment, drums, sediments, sludge, and other material contaminated with hazardous, toxic, or radioactive waste from one location to another.	**M^3**
.32.12	**TRANSPORTATION BY RAIL** Phase 1 to 5 • This element includes transporting soil, liquid, solids, equipment, drums, sediments, sludge, and other material contaminated with hazardous, toxic, or radioactive waste by rail.	**M^3**
.32.13	**TRANSPORTATION BY BARGE** Phase 1 to 5 • This element includes transporting soil, liquid, solids, equipment, drums, sediments, sludge, and other material contaminated with hazardous, toxic, or radioactive waste by barge, ship, or other water transport vessel.	**M^3**
.32.14	**TRANSPORTATION BY AIR** Phase 1 to 5 • This element includes transporting soil, liquid, solids, equipment, drums, sediments, sludge, and other material contaminated with hazardous, toxic, or radioactive waste by airplanes.	**M^3**
.32.15	**CONTAINER HANDLING** Phase 1 to 4 • This element includes costs associated with loading, unloading, and moving containers. Systems that can aid in handling operations include automatic guided vehicles, palletizing robots, cranes, hoists, elevators, and conveyors. Phase 5 • This element includes operation and maintenance of container-handling equipment.	**M^3** **M^3/YR**
.32.9x	**OTHER** Phase 1 to 5 • This element includes costs associated with other material handling and transportation activities.	**M^3**
.33	**DISPOSAL - COMMERCIAL**	
.33.01	**RESERVED FOR FUTURE USE**	
.33.02	**RESERVED FOR FUTURE USE**	
.33.03	**RESERVED FOR FUTURE USE**	
.33.04	**ON-SITE GOVERNMENT DISPOSAL COSTS, FEES, AND TAXES** Phase 1 to 6 • Costs, fees, or taxes paid by the generator to dispose of hazardous, toxic, or radioactive waste at an on-site facility owned and operated by same Government agency as the generator.	**M^3**
.33.05	**ON-SITE COMMERCIAL DISPOSAL COSTS, FEES, AND TAXES** Phase 1 to 6 • Costs, fees, or taxes paid by the generator to dispose of hazardous, toxic, or radioactive waste at an on-site commercial facility located on the waste generator's site but owned and operated by a private company.	**M^3**
.33.06	**OFF-SITE DOE DISPOSAL COSTS, FEES, AND TAXES** Phase 1 to 6 • Costs, fees, or taxes paid by the generator to dispose of hazardous, toxic, and/or radioactive waste at an off-site facility owned and operated by DOE.	**M^3**

ECES #	ECES DESCRIPTION	UOM
.33.07	**OFF-SITE OTHER GOVERNMENT DISPOSAL COSTS, FEES, AND TAXES** Phase 1 to 6 • Costs, fees, or taxes paid by the generator to dispose of hazardous, toxic, or radioactive waste at an off-site facility owned and operated by a Government agency other than the generator agency.	**M^3**
.33.08	**OFF-SITE COMMERCIAL DISPOSAL COSTS, FEES, AND TAXES** Phase 1 to 6 • Costs, fees, or taxes paid by the generator to dispose of hazardous, toxic, or radioactive waste at an off-site commercial facility. The disposal facility is owned and operated by a private company, and the facility is located outside of waste generator property.	**M^3**
.33.09	**DISCHARGE TO POTW** Phase 4 to 5 • Discharge contaminated wastewater to publicly owned treatments work for recycling, storage, treatment, or discharge.	**M^3**
.33.9x	**OTHER** Phases 1 to 5 • This element includes all other activities involved in commercial disposal not described by the above-listed categories.	**M^3**
.34	**AIR EMISSION AND OFF-GAS TREATMENT**	
.34.01	**BIOFILTRATION** Phase 4 • This element includes using a biofilter to remove vapor phase organic streams using a biomass or soil column where the streams are degraded by microorganisms in the soil. Specific strains of bacteria may be introduced into the filter and optimal conditions provided to preferentially degrade specific compounds. Phase 5 • This element includes operations and maintenance activities such as inspecting the unit, clearing the area, mixing and feeding chemicals, making repairs, and performing other activities to enhance microorganisms.	**M^3** **M^3/YR**
.34.02	**HIGH ENERGY CORONA** Phase 4 • This element includes using a High Energy Corona (HEC) mobile unit, using high-voltage electricity to destroy gaseous VOCs at room temperature. The HEC reactor is a glass tube filled with glass beads through which the pretreated contaminated off-gas is passed. Each reactor is 2 inches in diameter, 4 feet long, and weighs less than 20 pounds. A high-voltage electrode is placed along the centerline of the reactor, and a grounded metal screen is attached to the outer glass surface of the reactor. A high-voltage power supply is connected across the electrodes to provide 0-50 mA of 60-Hz electricity at 30 kV. The electrode current and power depend upon the type and concentration of contaminant. HEC equipment consists of: HEC reactor in which the VOCs are destroyed; inlet and outlet piping containing process instrumentation to measure humidity, temperature, pressure, contaminant concentration, and mass flow rate; means for controlling inlet flow rates and inlet humidity; and a secondary scrubber. Phase 5 • This element includes operations and maintenance activities such as inspecting the unit, operation of equipment, replacing parts and making repairs.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.34.03	**TUNABLE HYBRID PLASMA REACTOR** Phase 4 • This element includes using a reactor to destroy organics or oxidize them to non-toxic chemicals through their interaction with the electrons and plasma generated from the electron beam. The reactor uses a moderate energy electron beam (100-300 keV) injected into atmospheric air containing the organic contaminants. Because plasma is generated, use of either alternating current or direct current electric fields allows a further increase in the electron and gas temperatures to optimize the treatment process. The high degree of tunability of the reactor gave rise to the name tunable hybrid plasma reactor. Phase 5 • This element includes operations and maintenance activities such as operation of equipment, inspecting the unit, replacing parts, and making repairs.	**M^3** **M^3/YR**
.34.04	**MEMBRANE SEPARATION** Phase 4 • This element includes using membrane separation to treat feed streams that contain dilute concentrations of VOCs. The organic vapor/air separation technology involves the preferential transport of organic vapors through a nonporous gas separation membrane (a diffusion process analogous to pumping saline water through a reverse osmosis membrane). In this system, the feed stream is compressed and sent to a condenser where the liquid solvent is recovered. The condenser bleed stream, which contains approximately 5,000 ppm of the VOC, is then sent to the membrane module. The membrane module comprises modules of thin film membranes separated by plastic mesh that are wound spirally around a central collection pipe. In the membrane module, the stream is further concentrated to 3% VOC. The concentrated stream is returned to the compressor for further recovery in the condenser. Equipment includes compressors, membranes, instrumentation and control, and piping. Phase 5 • This element includes operations and maintenance activities such as operation of equipment, inspecting the unit, replacing parts, and making repairs.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.34.05	**CATALYTIC OXIDATION** Phase 4 • This element includes using catalytic oxidation to destroy contaminants in the exhaust gas from air strippers and SVE systems. The addition of a catalyst accelerates the rate of oxidation by adsorbing the oxygen and the contaminant on the catalyst surface where they react to form carbon dioxide, water, and hydrochloric gas. The catalyst enables the oxidation reaction to occur at much lower temperatures than required by a conventional thermal oxidation. VOCs are thermally destroyed at temperatures typically ranging from 320°C-540°C (600°F-1000°F) by using a solid catalyst. First, the contaminated air is directly preheated (electrically or, more frequently, using natural gas or propane) to reach a temperature necessary to initiate the catalytic oxidation (310°C-370°C [600°C-700°F]) of the VOCs. The preheated VOC-laden air is passed through a bed of solid catalysts where the VOCs are rapidly oxidized. Thermal oxidizers can often be converted to catalytic units after initially high influent contaminant concentrations decrease to less than 1,000-5,000 ppm. Catalyst systems used to oxidize VOCs typically use metal oxides such as nickel oxide, copper oxide, manganese dioxide, or chromium oxide. Noble metals such as platinum and palladium may also be used. Equipment includes blowers, heaters, heat exchangers, instrumentation and control, and catalyst bed. Some systems might need scrubbers. Phase 5 • This element includes operations and maintenance activities such as inspecting the unit, replacing parts, and making repairs.	**M^3** **M^3/YR**
.34.06	**THERMAL OXIDATION** Phase 4 • This element includes using thermal oxidation to destroy contaminants in the exhaust gas from air strippers and SVE systems. Thermal oxidation units are typically single-chamber, refractory-lined oxidizers equipped with a propane or natural gas burner and a stack. Lightweight ceramic blanket refractory is used because many of these units are mounted on skids or trailers. If gasoline is the contaminant, heat exchanger efficiencies are limited to 25%-35%, and preheat temperatures are maintained below 180°C (530°F) to minimize the possibility of ignition occurring in the heat exchanger. Flame arrestors are always installed between the vapor source and the thermal oxidizer. Burner capacities in the combustion chamber range from 0.5-2 million BTUs per hour. Operating temperatures range from 400°C-870°C (760°F-1,600°F), and gas residence times are typically one second or less. Phase 5 • This element includes operations and maintenance activities such as operation of equipment, inspecting the unit, replacing parts, and making repairs.	**M^3** **M^3/YR**
.34.07	**ULTRAVIOLET OXIDATION** Phase 4 • This element includes using UV oxidation to break down the chemical bonds under the influence of UV light and oxidants. Products of photo-degradation vary according to the matrix in which the process occurs, but the complete conversion of an organic contaminant to CO_2, H_2O, etc. is not probable. Equipment includes UV lamps, storage for oxidants, piping, process pumps, instrumentation and monitors, and off-gas treatment if ozone is used. Phase 5 • This element includes operations and maintenance activities such as inspecting the facility, preparing chemicals, replacing parts, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.34.08	**VOC RECOVERY AND RECYCLE** Phase 4 • This element includes using VOC recovery to capture volatile organic compounds from air streams. This technology is related to vapor phase carbon adsorption. A Brayton-cycle heat pump is used to condense VOCs from an air stream, a process that offers the potential for both recovery and either on-site or off-site recycling of a wide range of VOCs. The VOC-laden air stream comes from either vapor vacuum extraction of soil or air stripping of contaminated groundwater. The technology consists of activated carbon adsorbers located at each extraction well, plus a truck-mounted BCHP to regenerate the adsorbers on a periodic basis. The VOC-laden air from the well is passed through the carbon bed, adsorbing the VOCs. When the bed becomes saturated, hot nitrogen from the regenerator is used to desorb the VOCs from the bed. The nitrogen passes through a chiller, is compressed and then cooled in a recuperation unit where 50%-80% of the organics are recovered. The partially depleted nitrogen stream is then expanded through a turbine, lowering the temperature to as low as -101^{o}C (-150^{o}F) and condensing the remaining organics. The now-clean nitrogen passes through the recuperation unit to cool the VOC-laden nitrogen before returning to the carbon bed. The only outputs will be the clean off-gas from the well and a small amount of recovered organic. Phase 5 • This element includes operations and maintenance activities such as operation of equipment, inspecting the facility, replacing parts, and making repairs.	**M^3** **M^3/YR**
.34.09	**INTERNAL COMBUSTION ENGINE** Phase 4 • This element includes using an internal combustion engine to burn organic contaminants as fuel. When the concentration of organics is too low, auxiliary fuel is added to enhance the oxidation. Phase 5 • This element includes operations and maintenance activities such as operation of equipment, replacing parts, and making repairs.	**M^3** **M^3/YR**
.34.10	**GRANULAR ACTIVATED CARBON ADSORPTION GAS/VAPOR** Phase 4 • This element includes using vessels containing activated carbon to remove organic contaminants from gaseous waste streams. Organic molecules are adsorbed into the carbon, which is either replaced or regenerated. Items associated with carbon adsorption are granular activated carbon columns, pre-filters, and items associated with regenerating the spent carbon. Organic carbon analyzers are used for on-line control. Costs include the cost of a GAC column, and in most cases, pumps, piping, and regeneration equipment. Phase 5 • This element includes operations and maintenance activities such as inspecting the carbon unit, cleaning or regenerating the carbon, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.34.11	**ALKALI BED REACTOR** Phase 4 • This element includes using a chemical treatment technique to rapidly degrade chlorinated organic compounds in strong alkali solutions at elevated temperatures. Soda lime, a highly alkaline solid composed of 95% CaO and 5% NaOH, is presented to a contaminated air stream in a packed bed. The destruction process is essentially one step for both destruction of SVOC and neutralization of any acid vapors. The reaction takes place at relatively low temperatures (350°C-400°C) as compared to thermal oxidation, which suggests some catalytic activity on the part of the soda lime. The end product is a mixture of benign, non-hazardous salts consisting of Ca and Na chlorides and carbonates. Phase 5 • This element includes operations and maintenance activities such cleaning the area, inspecting the facility, making repairs, replacing components, and removing and handling waste.	**M^3** **M^3/YR**
.34.12	**FLAMELESS THERMAL OXIDATION** Phase 4 • This element includes using a heated, packed bed reactor containing a porous inert matrix composed of spherical or saddle shaped ceramic beads. The contaminated off-gas stream is ducted into a gas distribution plenum. The stream is then introduced to the packed bed where the interstitial geometry enhances the mixing and combustion of contaminated air and fuel. The surface characteristics of the interstitial matrix promote heat transfer. Its thermal capacitance dampens temperature changes and promotes stability of the combustion process even when significant changes occur in the concentration or composition of the off-gas stream. As the stream proceeds through the packed bed, it is rapidly heated to oxidation temperatures of 870°C-980°C (1,600°F-1,800°F) and VOC/SVOCs are broken down into combustion products. The interstitial geometry of the packed bed promotes homogeneous oxidation of all reactants avoiding the possibility of contaminants bypassing the flame reaction zone as can occur in thermal oxidation units. As with thermal and catalytic oxidation, flameless thermal oxidation systems make use of thermal recapture techniques to recover heat from the exhaust stream. Phase 5 • This element includes operations and maintenance activities such as cleaning the area, inspecting the facility, making repairs, replacing components, and removing and handling waste.	**M^3** **M^3/YR**
.34.13	**CONDENSATION** Phase 4 • This element includes using condensation to remove VOCs from a non-condensable gas stream. By varying the gas stream temperature and pressure, organic vapors condense and separate from the non-condensable gas stream. The condensed organics are collected and sometimes reused. Surface condensers are shell and tube heat exchangers where coolant flows inside the tube and the condensed VOC stream is collected outside the tube. Contact condensers operate by spraying a cool liquid directly into a gas stream to cool and condense the organic vapors. Phase 5 • This element includes operations and maintenance activities such as inspecting treatment units, operation of equipment, cleaning the area, and repairing components.	**M^3** **M^3/YR**

ECES #	ECES DESCRIPTION	UOM
.34.14	**FLARING** Phase 4 • This element includes using flares, open-flame systems for the thermal destruction of volatile organic compounds. A typical application in the remediation area is treating off-gases from landfills. These off-gases may contain high concentrations of methane. However, in most cases, heating value of these gases may not be recovered economically. In a typical flare system, a pilot burner ignites the off-gases at the flare tip. For smokeless operation, flares may need an air or steam supply to provide efficient gas/air mixing. Phase 5 • This element includes operations and maintenance activities such as inspecting the treatment unit, operation of equipment, cleaning the area, and repairing components.	**M^3** **M^3/YR**
.34.15	**SYNTHETIC RESIN ADSORBTION** Phase 4 • This element includes using synthetic resins to adsorb and remove contaminant form off gaseous waste streams. The resins are regenerated by thermally desorbing the contaminants, which are transferred to a more concentrated off-gas stream for treatment. Phases 5 and 6 • This element includes utilities and energy for operation and maintenance activities such as regenerating resins, inspecting the treatment unit, cleaning the area, and repairing components. Additional elements from X.34, Air Emission and Off-Gas Treatment should be used for treatment of regenerant off-gas streams.	**M^3** **M^3/YR**
.34.9x	**OTHER** Phase 4 • Construct or install other air emission and off-gas treatment technologies. Phase 5 • Perform O&M activities such as inspecting facilities, replacing materials, clearing the area, and making repairs on other air emission and off-gas treatment technologies.	**M^3** **M^3/YR**
.9X	**OTHER (USE NUMBERS 90-99)** Phase 1 to 6 and 8 • This element includes all second level activities not described in second-level elements X.01.xx to X.34.xx.	

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